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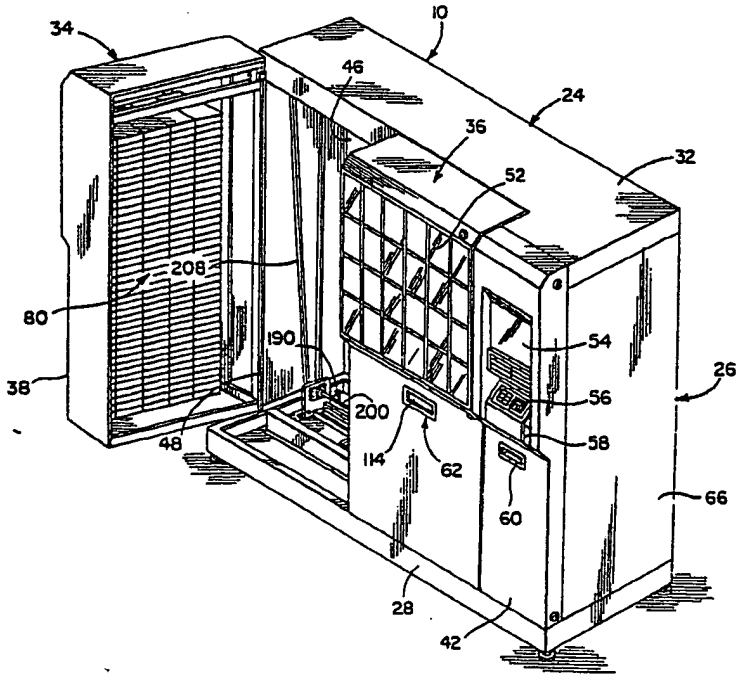


(57) Abstract

An article merchandising machine (10) has an article gripper (270) moved by a robotic transporter (190) in a transport plane between an access port (62) and video cassette storage cells (98) mounted in doors (34, 36) on the machine. The transporter also moves the gripper in a direction intersecting the transport plane. The gripper (270) is moved under programmed control of a computer (64) and data inputted from a keypad (56) and card reader (58) to perform merchandising transactions. An emergency storing bin (88) accepts articles for return only during transaction shutdowns caused by robotic transporter malfunctions which persist after a recovery process. Transactions aborted by failure of a scanner (186) to read identification data on articles returned to the access port may be resumed through use of the keypad.

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# MERCHANDISE TRANSACTION MACHINE AND SYSTEM

## BACKGROUND OF THE INVENTION

This invention relates generally to the merchandising of manufactured articles or products and more particularly to a vending machine and an associated product merchandising system.

Automatic vending machines within which manufactured articles or products are stored and dispensed therefrom to customers in response to coded inputs from a keypad after the machine is enabled by insert of a coin or token, are already well known. The dispensing of articles together with the reception of articles in the form of paper currency and bank deposits, respectively, is also well known in the art in connection with automatic teller machines presently in wide-spread use. Such automatic teller machines also involve the recording of transactions, the updating of computer memories, the issuing of receipts, the operation of visual monitors to provide user instruction, as well as other related banking functions.

The use of the attributes of the automatic teller machines in combination with automatic product vending operations for merchandising of manufactured articles such as video recorder

cassettes has already been proposed and commercialized to a limited degree, involving the use of automatic vending machines with control systems enabled through credit card validation operations. Such prior vending machines and associated operational controls have suffered from various problems in attempting to adapt existing computer technology and automated vending equipment to the merchandising of manufactured products such as video cassettes. Such problems involve, for example, operational reliability and efficiency, servicing facility and transaction security.

Shutdown of such vending machine occurs as a result of error signals generated in response to malfunctions to prevent customers from returning previously rented products. Customers are thereby not only inconvenienced, but are subjected to increased rental charges because of rental time prolonged through no fault of their own.

It is therefore an important object of the present invention to provide a manufactured article merchandising machine and system through which rental, purchase and article return transactions may be automatically performed together with related transaction accounting operations based on validated customer credit status.

It is also an object of the present invention, in accordance with the foregoing object to perform the various merchandising and related functions in a more efficient and reliable manner than was heretofore possible based on existing and known technologies.

It is therefore an important object of the present invention to provide a manufactured article merchandising machine and system through which rental, purchase and article return transactions may be automatically performed together with related transaction accounting operations based on validated customer credit status without penalizing the customer because of machine shutdown as a result of internal malfunction.

It is an additional important object of the present invention, in accordance with the foregoing object, to perform the various merchandising and related functions in a more efficient and convenient manner for the customer by enlargement of the available mode selection options.

## SUMMARY OF THE INVENTION

In accordance with the present invention, an automatic vending type of machine is provided having a cabinet enclosing at one end a control compartment closed by a panel assembly mounting a visual display monitor, a keypad, a magnetic card reading slot and a receipt issuing port. The machine cabinet also encloses a relatively large transport compartment closed by at least two door assemblies within which a plurality of storage cells are mounted. One of the door assemblies also mounts an article access port unit through which articles are inserted and withdrawn from the machine. The access port unit extends through the storage assembly associated with its mounting door and projects into the transport compartment within which a robotic transporter is mounted. The robotic transporter is operative under programmed computer control

to transport articles between a reference location in a transport plane spaced from the storage cells and a plurality of locations in such plane aligned with the storage cells and the access port. The storage assembly includes at least one storage cell which serves to realign misaligned articles carried by a gripper device during transport by the robotic transporter. The storage assembly also provides separate space for receiving articles to be discarded or removed from the merchandising process. Thus, the article gripper device associated with the robotic transporter travels in horizontal and vertical directions perpendicular to each other within the transport plane, between the access port location, the locations aligned with the storage cells, the realignment location and the article discard location. The robotic transporter includes screw and nut drives for effecting linear movement of the article gripper in the aforementioned horizontal and vertical transport directions. The gripper is also moved in a third direction intersecting the transport plane at one of the aligned locations to which it travels from the reference location in order to insert or withdraw an article with respect to a storage cell, the realignment zone or the access port. Such insertion or withdrawal movement of the gripper is effected by a third linear screw and nut drive of the robotic transporter.

A frictional drive device is associated with the access port unit for displacing the article received therein to a position projecting into the transport compartment for code reading purposes. In the case of a video cassette, the article is retained

within a holder box having openings through which an identification bar code is exposed to a bar code scanner mounted on the gripper. The top surface of the holder mounts an additional coded strip to be read by an optical scanner directly mounted on the access port unit. The bar code scanner on the gripper is adapted to be aligned with the bar code location on the article projecting into the travel compartment when the gripper is moved to one of the aligned storage locations as aforementioned. Various code reading functions may thereby be performed in accordance with the computer control program which also dictates other robotic transporter movements. The gripper is thus displaceable vertically by the robotic transporter a small incremental amount from the reading position in order to align a lower fixed gripper jaw with the selected storage zone or access port unit while the gripper is open. The gripper is then horizontally displaced by the robotic transporter an incremental distance toward the storage assembly from the transport plane so that the article projecting therefrom may be clamped to the gripper upon closing of its upper movable jaw in order to withdraw an article from a selected storage zone or the access port. The gripper opening and closing sequence is reversed when inserting an article into an empty storage zone or access port. During movement of the gripper toward the storage assembly, the bar code scanner aforementioned is withdrawn from its reading position.

The screw and nut drive for imparting movement to the gripper in the insert/withdrawal direction is coupled to the

gripper through a lost-motion connection established by a collision signalling device, by means of which a signal is generated whenever excessive resistance to movement is experienced by the gripper as a result of collision error. Such collision signal is operative to effect programmed transport of an article carried by the gripper to the aligning location and insertion of the article into the alignment cell followed by transport of the article to another storage zone. If a collision signal is again generated during an attempted insertion of the article into the other storage zone, computer programmed operation initiates transport of the article by the robotic transporter to the disposal zone of the storage assembly for discarding the article therein.

The computer controlled operation of the machine is also programmed in accordance with service modes for loading and unloading of articles in the storage assemblies, repair of the machine and replacement of components therein. The mounting of the storage assemblies in the doors of the machine provides easy access for repair and servicing of the robotic transporter as well as for article loading and unloading purposes. The aforementioned incremental movements of the gripper for scanner reading, gripping and release of articles, enables the efficient use of soft strip coded labels on the article thereby reducing memory loading of the process controlling computer in view of the storage of data on the coded labels.

The process or operations controller is in the form of a local computer having facilities for intercommunication with a

central host computer whereby the machine may be operated as part of a network system. Programmed control of door locks associated with door assemblies provides security for the machines as well as to limit the servicing of the machines to validated personnel through use of magnetically coded service identification cards read by the same magnetic reader of the machine which reads credit cards of customers.

When shutdown occurs with respect to normal return mode operations, an emergency return mode is enabled to permit return of articles through the emergency return port aforementioned, rather than the normal access port. Emergency return mode of operation may then be initiated pursuant to instructions displayed on the monitor by code entry through the keypad. The articles so returned are stored in a separate storage bin aligned with the emergency return port and are registered by a sensor and counter to limit the number of emergency returns accepted in accordance with the capacity of the emergency return storage bin.

Where the normal return mode operation is aborted by failure of the scanner to read the identifying code on the article, because of scanner malfunction or code label damage, the customer may enter the identification code for the article, pursuant to displayed instructions, through the keypad to establish a modified normal return mode with the article in the normal transaction access port.

Operation of the machine is also programmed in accordance with service modes for loading and unloading of articles in the

transaction storage assemblies as well as for repair of the machine and replacement of components therein. Rear panel access doors provide easy access for repair and servicing of the robotic transporter where opening of the front door assemblies is blocked by installation of the machine providing for convenient front exposure for the ports, keypad and display monitor to customers.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

## BRIEF DESCRIPTION OF THE DRAWING FIGURES

Figure 1 is a front elevation view of an article merchandising machine constructed in accordance with one embodiment of the present invention.

Figure 2 is a perspective view showing the machine of Figure 1 with one of the door assemblies thereof in an open position.

Figure 3 is a top plan view of the machine shown in Figures 1 and 2 with both of the door assemblies thereof in open positions.

Figure 4 is a perspective view of a typical video recorder cartridge and a holder box to be utilized in connection with the machine shown in Figures 1-3.

Figure 5 is a partial side section view taken substantially through a plane indicated by section line 5-5 in Figure 3.

Figure 6 is a partial section taken substantially through a plane indicated by section line 6-6 in Figure 3 with the access port unit removed.

Figure 7 is a partial section taken substantially through a plane indicated by section line 7-7 in Figure 6.

Figure 8 is an enlarged partial section view taken substantially through a plane indicated by section line 8-8 in Figure 6.

Figure 9 is an enlarged partial section view taken substantially through a plane indicated by section line 9-9 in Figure 1.

Figure 10 is a partial section view taken substantially through a plane indicated by section line 10-10 in Figure 9.

Figure 11 is a partial section view taken substantially through a plane indicated by section line 11-11 in Figure 9.

Figure 12 is an enlarged partial section view taken substantially through a plane indicated by section line 12-12 in Figure 11.

Figure 13 is a partial front section view taken substantially through a plane indicated by section line 13-13 in Figure 3.

Figure 14 is a partial section view taken substantially through a plane indicated by section line 14-14 in Figure 13.

Figure 15 is an enlarged partial section view taken substantially through a plane indicated by section line 15-15 in Figure 13.

Figure 16 is a partial section view taken substantially through a plane indicated by section line 16-16 in Figure 15.

Figure 17 is a partial section view taken substantially through a plane indicated by section line 17-17 in Figure 13.

Figure 18 is an enlarged partial section view taken substantially through a plane indicated by section line 18-18 in Figure 1.

Figure 19 is a section view taken substantially through a plane indicated by section line 19-19 in Figure 18.

Figure 20 is perspective view of a portion of the track assembly supporting the gripper within the machine.

Figure 21 is a partial section view taken substantially through a plane indicated by section line 21-21 in Figure 18.

Figure 22 is a enlarged partial section view taken substantially through a plane indicated by section line 22-22 in Figure 19.

Figure 23 is a partial section view corresponding to that of Figure 18 but showing the gripper in a clamping position.

Figure 24 is a functional block diagram showing the interrelationship between various mechanical and control components of the machine.

Figure 25 is a functional block diagram illustrating the interfacing between various electrical components of the control system associated with the machine.

Figure 26 is a block diagram diagrammatically illustrating a machine network system.

Figure 27 is a program flow chart illustrating the basic process associated with customer operation of the machine.

Figure 28 is a top plan view of the keypad associated with the machine.

Figure 29 is a program flow chart diagramming the transport processes associated with operation of the machine.

Figures 30 and 31 are program flow charts respectively illustrating the rent and return program modes of the machine software.

Figure 32 is a program flow chart diagramming the programmed error processes associated with the operation of the machine.

Figure 33 is a program flow chart diagramming the service modes associated with programmed control of the machine.

Figure 34 is a perspective view showing a vending machine constructed in accordance with another embodiment of the present invention, with one of the front door assemblies thereof in an open position.

Figure 35 is a top plan view of the machine shown in Figure 35 with the front door assemblies and the rear access doors thereof in open positions.

Figure 36 is an enlarged partial section view taken substantially through a plane indicated by section line 36-36 in Figure 34.

Figure 37 is a functional block diagram showing interrelationships between various mechanical and control components of the machine shown in Figures 34-36.

Figure 38 is a program flow chart diagramming the normal return mode of operation modified in accordance with the present invention.

Figure 39 is a program flow chart diagramming an error recovery mode of operation in accordance with the present invention.

Figure 40 is a program flow chart diagramming an emergency return mode of operation in accordance with the present invention.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings in detail, Figures 1, 2 and 3 illustrate a dispensing machine generally referred to by reference numeral 10 adapted to handle transactions involving video recording cassettes as the merchandising article in accordance with one embodiment of the invention. A typical video cassette 12 as shown in Figure 4, is to be merchandised through machine 10 while retained within a holder or handling box 14. In the illustrated embodiment, the video cassette 12 has scanner readable identification data in the form of a bar code on strips 16 adhesively attached to opposite longitudinal ends of the cassette

housing extending from one elongated side as shown. The bar codes on strips 16 are exposed through openings 18 in the ends of the holder 14 which also has a soft strip 20 adhesively attached to the top thereof with optically readable data imprinted thereon to provide detailed information regarding the article or cassette 12 carried in the holder. The holder is made of a suitable plastic material having a friction surface portion 22 through which the holder is displaced by frictional drive as will be described hereinafter.

The machine 10 has an outer cabinet structure generally referred to by reference numeral 24 formed by an intermediate housing portion 26 supported on a base portion 28 having level adjusted feet 30 as shown in Figure 1. The top of the cabinet structure is closed by a roof portion 32. While the base portion 28 is substantially rectangular, the top portion 32 is generally L-shaped to accommodate two door assemblies 34 and 36. In the closed positions of the door assemblies, the front door panels 38 and 40 thereof are substantially flush with the front panel 42 closing a control compartment 44 on the right side within the cabinet as viewed in Figure 3. The door assemblies 34 and 36, themselves substantially seal a common travel or transport compartment 46 within the cabinet as indicated in Figure 2. The left hand door assembly 34 is pivotally mounted by a hinge 48 on the left end of the intermediate housing portion of the cabinet while the door 36 is pivotally mounted by the base and roof portions 28 and 32 of the cabinet along hinge axis 50 so that both

door assemblies swing open in clockwise directions as shown in Figure 3 to expose the travel compartment 46 for servicing purposes.

The front panels 38 and 40 of the door assemblies have forwardly projecting sections mounting a plurality of posters 52 displaying information on the contents of the video cassettes available for rental or purchase. The front panel 42 closing the control compartment 44 at the right side of the cabinet mounts the screen of a visual display monitor 54 through which instructional data and other information is displayed to the user or servicing personnel. A keypad 56 is disposed below the visual display 54 for entry of operational mode selection data. Machine enabling inputs are entered by insertion into a vertical slot 58 of credit or service identification cards containing magnetically readable validating data. A printed receipt delivery port 60 is mounted on the panel 42 below the keypad 56 and card slot 58. A cassette access port unit 62 is mounted on the front panel 40 of the door assembly 36 below the selection display posters 52.

Referring now to Figure 5, the control compartment 44 of the cabinet encloses the visual display monitor 54 which is electronically connected to a local computer 64 of an IBM PC XT compatible type having a hard disc memory of large capacity and facilities for intercommunication with other computers. The keypad 56 aforementioned is connected to the computer 64. Also mounted within the control compartment on the end wall 66 of the cabinet below the computer 64 is a motor controller circuit assembly 68 to

which the computer is electrically connected. The local computer 64 is furthermore connected to a journal printer 70 located above the display monitor 54 and a receipt printer 72 located therebelow. The printer 70 records transactions performed by the machine 10 when operated independently of any centrally controlled network of machines so that its transaction recordings may be periodically removed therefrom by servicing personnel. A paper roll 74 is supported below printer 72 to supply a strip of paper fed to the printer 73 on which transaction receipts are imprinted under control of the computer 64. Severed print-out receipts ejected from printer 72 are deposited into a drop chute 76 terminated at its lower end by the receipt delivery port 60 aforementioned.

The article access port unit 62, hereinbefore referred to, projects inwardly from the front panel 40 of the door assembly 36 through one of two cassette storage assemblies 78 as shown in Figure 6. The storage assembly 78 mounted on the inside of door assembly 36 is similar to the storage assembly 80 mounted in the other door 34 as shown in Figure 2, except for an opening 82 in the storage assembly 78 through which the port unit 62 (omitted from Figure 6) extends from the front door panel 40. The storage assembly 78 includes a frame 84 peripherally secured to the door panel 40, the frame including a pair of vertical posts 86 exposed within opening 82 as shown in Figure 6 for support of port unit 62 as will be described hereinafter. Horizontal frame members 88 of the storage frame 84, as shown in Figure 7, have attached thereto a back panel 90 from which storage partition walls 92 project in

parallel spaced relation to end walls 94. Thus, the partition walls 92 divide the storage assembly into vertical spaces which open into the transport compartment 46 when the door is closed. Such vertical spaces are horizontally divided into storage cells or zones 98 by support rods 96 which extend between the side walls 94 and through the partition walls 92. Inventoried cassettes are thereby supported within the storage zones 98 as the articles being stored in the cabinet. The side walls 94 and partition walls 92 terminate at their lower ends in spaced relation to the lower end of the frame 84 so as to form a cassette disposal zone 100 into which cassettes are discarded.

Each storage zone 98 is provided with flexible elements 102 anchored to the partition walls 92 and side wall 94 as more clearly seen in Figure 8. Such elements 102 wipingly contact the sides of the cassette holders 14 through which the cassettes are stored in the storage zones, in order to yieldably maintain proper orientation of each holder while supported in a storage zone on the rods 96.

One of the storage zones 99 formed between side wall 94 and the adjacent partition wall 92, has outwardly diverging flanges 104 as shown in Figures 6 and 7 in order to engage a misaligned cassette holder inserted into such zone. Such realigning action of the flanges 104 restores the cassette holder to its proper orientation for subsequent insertion into another storage zone 98 as will be described hereinafter. The storage zone 99 with which flanges 104 are associated, is used only for realigning purposes.

The storage assembly 78 described with respect to Figures 6, 7 and 8 is the same as the storage assembly 80 in door 34 except for the opening 82 as aforementioned. The opening 82 is occupied by the port unit 62 as shown in Figures 9-12. The port unit includes an elongated guide member 106 having an inverted U-shaped cross-section formed by a top wall 108 and parallel spaced side walls 110 depending therefrom. The guide member is adjustably positioned with one end 112 in alignment with the frame port opening 114 in the door panel 40 by support rods 116 extending rearwardly from the vertical frame posts 86 of the storage assembly 78 hereinbefore described. The support rods 116 project through openings in brackets 118 and 120 secured to the side walls 110 of the guide member 106. Lock nuts 122 are threadedly mounted on the end portions of the support rods 116 for locking the guide member in its adjusted position as shown in Figure 11.

A plurality of guide rollers 124 are rotatably mounted between the side walls 110 of the guide member 106 and are spaced below the top wall 108 thereof for guiding support of a cassette holder 14 during reception or withdrawal as shown in Figure 9. The end 112 of the guide member aligned with the port opening 114 in the door panel is adapted to be closed or blocked by a shutter element 126 that is slidably mounted, for vertical displacement, by a pair of track members 128 secured to the guide member 106 at its end 112. A flange 130 projects rearwardly from the shutter element above the top wall of the guide member for engagement by a roller 132 mounted on a notched disc 134 of a shutter actuator

mechanism generally referred to by reference numeral 136. The actuator mechanism includes a drive motor 138 and associated reduction gear 140 mounted on a support bracket 142 secured to the top wall 108 of the guide member adjacent to end 112. A motor control box 140 is wired to the drive motor 138, the operation of which is controlled through a motion control switch 142 having a switch actuator arm 144 engaged with the rim of the disc 134 as more clearly seen in Figure 10. Thus, the shutter 126 is vertically displaced between its closed position as shown in Figure 9 and an upwardly displaced open position by programmed control of the drive motor 138 as will be described in detail hereinafter. A limit switch 146 is associated with the drive motor 138 for that purpose as shown in Figure 9.

When the shutter 126 is opened, a cassette holder 14 may be inserted into the guide member of the port unit 62 so that it rests on the guide rollers 124 while engaged by the frictional rim 148 of a drive wheel 150 forming part of a frictional drive engaging mechanism 152 associated with the port unit 62. The cassette holder 14 is thereby displaced from a position assumed when inserted, to a data reading position projecting rearwardly from the flanged end portion 154 of the guide member into the travel compartment 46 of the cabinet as shown in Figure 9. The drive wheel 150 is rotatably mounted by bearing assemblies 156 on a support plate 158 pivotally mounted on the top 108 of the guide member 106 by means of a hinge 160 as shown in Figures 9 and 11. A power shaft 162 extends from the drive wheel to a drive motor 164

mounted on a support flange 166. Thus, the drive wheel 150 projecting through a slot 168 in the top wall 108 of the guide member 106 is held in frictional contact with the surface portion 22 of the holder 14 under the bias of gravity and a hold-down spring device 170 projecting through a slot 172 in the edge of the hinged support plate 158.

The hold-down spring device 170 as shown in Figure 12 includes a nut 174 fixed to the top wall of the guide member 106 for threadedly anchoring a bolt 176 projecting upwardly through slot 172. Washer 178 abutting the support plate 158 and bridging the slot 172 is engaged by one axial end of a coil spring 180 encircling the bolt 176. The other axial end of spring 182 engages a washer 182 underlying the head 184 of the bolt to thereby exert a predetermined downward spring bias on the plate 158 to provide the proper frictional drive contact pressure as well as to accommodate upward retraction of the drive wheel when a cassette holder 14 is inserted.

As shown in Figures 9 and 11, an optical reader 186 is mounted in alignment with an opening 188 in the top wall 108 of the guide member through which the coded soft strip 20 on the cassette holder is exposed while the holder is in reading position. Optical reading of the soft strip 20 thereby provides additional input data to the system with which the machine 10 is associated as will be explained hereinafter.

When the cassette holder 14 is displaced by the frictional drive mechanism 152 to its data reading position as

hereinbefore described, it is also adapted to be returned to storage by a robotic transporter generally referred to by reference numeral 190 located within compartment 46 as shown in Figure 2. The robotic transporter 190 as shown in Figure 13, includes a drive motor 192 fixedly mounted on the base portion 28 of the cabinet with its power shaft connected by coupling 198 to a linear driving screw shaft 200 connected at one end opposite the motor 192 to a sprocket gear 202. The screw shaft 200 is rotationally supported by a bearing assembly 204 carried on a support plate 206 adjacent sprocket gear 202, the support plate 206 being secured to the base portion of the cabinet as shown. The sprocket 202 is drivingly connected by a positive drive belt 208 to a sprocket gear 210 connected to one end of an upper spiral screw shaft 212 supported by bearing assemblies 214 and 216 on the roof portion 32 of the cabinet for rotation about a horizontal axis fixed to the cabinet in parallel spaced relation to the rotational axis of the screw shaft 200. The screw shafts 200 and 212 effect movement in one horizontal transport direction through recirculating ball type nut assemblies 218 and 220 respectively mounted on and drivingly engaged with the respective screw shafts 200 and 212. The screw shafts are simultaneously rotated at the same speed by drive motor 192 because of the driving connection of drive belt 208 entrained about sprockets 202 and 210 to which the screw shafts are respectively connected. The drive tension of belt 208 is maintained by an idler sprocket 222 slidably adjustable through a slot 224 in a plate 226 fixed to the roof portion 32 for support

of the bearing assembly 214 journaling the upper screw shaft 212, as more clearly seen in Figure 14.

The nut assemblies 218 and 220 are axially displaced along the screw shafts 200 and 212 by said simultaneous rotation thereof for imparting movement to a track 228 in the horizontal transport direction. A vertical screw shaft 230 is rotatably mounted by upper and lower bearing assemblies 232 and 234 fixed to upper and lower end portions of the track support 228 as shown in Figures 13 and 16. A coupling shaft 236 interconnects the nut assembly 220 with the track support 228 through the upper bearing 232, and a guide bracket 238 which is slidable along a fixed guide shaft 240 to prevent rotation of the nut assembly 220. A similar coupling and rotation preventing guide arrangement involving fixed guide 242 is provided for the lower end of the track support. Also, an L-shaped bracket 244 is secured to the lower end of track support 228 as shown in Figures 13 and 16 on which a drive motor 246 is mounted. The drive motor 246 is connected to a sprocket gear 248 drivingly connected by drive belt 250 to driven sprocket gear 252 connected to the lower end of the screw shaft 230. The screw shaft 230 is thereby rotated about a vertical axis movable with the track support 228 in the horizontal transport direction aforementioned.

As shown in Figure 15, the track support 228 has a vertically elongated bar 254 fastened to its web by spacers 256. The bar 254 extends laterally of the track support to carry an electric cable retainer 258 through which electrical conductors

extend for connection to the drive motor 246 and other electrical components horizontally movable with the track support 228, such as a horizontal motion limit contactor 260 carried by a bracket 262 secured to the lower end of the track support and vertical motion limit switches 264 carried at the lower and upper ends of the track support 228.

The track support 228 mounts vertical tracks 266 on its legs as shown in Figure 15 for guiding vertical transport movement of a track assembly 268 on which a gripper device 270 may be displaced in perpendicular transport directions in a common transport plane by rotation of the horizontal, fixed axis screw shafts 200 and 212 and the vertical, movable screw shaft 230 when the respective drive motors 192 and 246 are energized. The gripper device is thereby transported within the travel compartment of the cabinet between locations in the common transport plane operatively aligned with the storage zones 98, the realignment zone 99 and the port unit 62.

The track assembly 268 as shown by itself in Figure 20 includes a support plate body 272 mounting on one side a pair of spaced vertical rails 274 on L-shaped brackets 276. The rails 274 are adapted to be slidably received in the vertical tracks 266 on the track support 228. The other side of the plate body 272 mounts a horizontally elongated, channel-shaped track 278. A bearing block 280 is secured to one end of the plate body 272 above the track 278 for journaling one end of a screw shaft 282. As shown in Figure 18, the screw shaft 282 is driven at the end thereof

opposite bearing block 280 by a third drive motor 284 of the robotic transporter secured to the plate body 272 of the track assembly 268. The screw shaft 282 is thereby operative to axially displace a nut assembly 286 drivingly engaged therewith along a movable horizontal axis intersecting the common transport plane aforementioned at right angles thereto for imparting motion to the gripper device 270 in a cassette insertion and withdrawal direction relative to the storage assemblies or the port unit 62 extending through one of the storage assemblies 78. One end of the vertical track assembly 268 at which bearing block 280 is located, is therefore closely spaced horizontally from the edges of the partition walls 92 of the storage assemblies exposed to the travel compartment 46 of the cabinet.

The gripper device 270 has a frame generally referred to by reference numeral 288 to which mounting plate 290 is attached. The nut assembly 286 is coupled to the mounting plate 290 of the gripper device through a lost motion connection established by a collision signalling device 320, having a slide block 322 connected by lug 292 to the mounting plate 290 as shown in Figure 19. A rail 294 attached to one side of plate 290 opposite the gripper device is slidably received in the track 278 to guide movement of the gripper device and prevent rotation of the nut assembly 286 so as to confine it to axial motion along screw shaft 282 with the gripper device.

The gripper device 270 has a drive motor 296 mounted on its frame 288 opposite plate 290 as viewed in Figure 19. The drive

motor is drivingly connected through a crank pin 298 as shown in Figure 22 to a connecting rod 300 slidably received at its end opposite crank pin 298 within a sleeve 302 journaling a cam roller 304. The cam roller 302 is adapted to be received in an arcuate recess 306 of a movable gripper jaw 308 pivotally mounted in the gripper frame by pivot pin 310. The movable jaw 308 is biased downwardly by a pair of coil springs 312 laterally spaced from the jaw 308 on opposite sides thereof. The upper ends of the springs 312 are anchored to a pin 314 projecting laterally from the movable jaw 312 on opposite sides thereof as more clearly seen in Figure 19. The lower ends of springs 312 are anchored to the gripper frame 288 through a pin 316 extending through a lower jaw 318 fixed to the frame.

The collision signalling device 320 aforementioned, as shown in Figures 18, 19 and 21, is associated with the gripper device to register a collision with the gripper device caused, for example, by the erroneous delivery of an article clamped between the gripper jaws to a storage zone 98 already occupied. The slide block 322 of the collision signalling device is mounted on the nut assembly 286 and is biased by springs 324 to a normal position as shown in Figure 21. The springs 324 are anchored directly to the nut assembly 286 by a plate 326, non-conductively spaced by spacer 328 from a contact element 330. When an excessive resistance to movement of the gripper frame 288 is experienced because of a collision, the resistive force is transmitted by slide block 322 to the springs 324 causing axial deformation thereof and relative

displacement between the slide block and contact element 330 fixed to the nut assembly 286. In response to such relative displacement, a contactor 332 adjustably fixed to slide block 322 by bracket 334 engages the contact element 330 to generate the collision signal in cable 336.

Also carried on the frame of the gripper device 270 is a bar code scanner 338 as shown in Figures 18, 19 and 21. The scanner is supported on a block 340 above the jaws 308 in a normal reading position, as shown, under the bias of a spring 342. Opposite ends of spring 342 are accordingly anchored to the gripper frame by block 344 and to the scanner 338 by a block 346 connected by slide shafts 348 to the scanner mounting block 340. The gripper device 270 may be displaced by energization of drive motor 284 in one directional sense to a position in which the scanner 338 is closely spaced from the storage assembly or the port unit 62 for reading of the bar code on strip 16 of a cassette. Arrival of the gripper device to such bar code reading position is signaled by limit with 329 shown in Figure 19. The gripper device 270 is further displaced from the code reading position by a small incremental amount in the same directional sense after being displaced vertically by an incremental amount to an article clamping position in which the lower fixed jaw 318 thereof is aligned with one of the support rods 96 of a storage zone 98 as shown in Figure 23. When approaching such clamping position during vertical movement, the gripper motor 296 is energized to

upwardly displace movable jaw 308 against the bias of springs 312 so that the end of a cassette holder 14 projecting into the travel compartment may be received between the open jaws and then clamped between the jaws upon deenergization of drive 296 as shown in Figure 23. In such clamping position, the scanner 338 is retracted from its bar code reading position against the bias of spring 342 by an abutment element 350 engaging the scanner mounting block 340 as shown in Figure 23. The abutment element 350 is adjustably secured to a lower end of a plate 352 secured to and projecting from the bearing block 280 as shown in Figures 18 and 20.

It will be apparent from the foregoing description that the gripper device 270 may be transported by robotic transporter 190 along the common plane between the locations aligned with the access port unit 62, the storage zones 98, the realignment zone 99 and the disposal zone 100 as diagrammed in Figure 24. The robotic transporter is also operative to displace the gripper device 270 toward and away from the door storage at the locations aligned with storage zones 98, 99 and 100, or the access port 62 for data reading by means of scanners 186 and 338, and for clamping of the gripper device onto the cassette holders under control of its drive motor 296 as aforementioned. Travel of the gripper 270, on the other hand, is under control of programmed controller operation of computer 64 through the motion controller 68 having a step-by-step motion control characteristic in view of the incremental displacement requirement aforementioned. The local computer 64 acting as the process controller receives inputs from its memory

354 storing storage location data and an ID analyzer section 356 to which the outputs of the scanners 186 and 338 are connected. It is contemplated that additional inputs to the ID analyzer may be provided, such as the output of a weight sorting device utilized to determine the contents of certain types of products to be merchandised. The collision signal device 320 and the sensors collectively labeled 358 in Figure 24, which includes reference position sensors and motion limiting sensors such as the motion control switch 142 and limit switches 146, 260, 264 and 329 aforementioned, provide process feedback data to the controller 64.

The controller 64 also receives inputs from the keypad 56 as aforementioned in connection with Figure 5 for selection of the programmed operational mode of machine 10 as well as article selection codes. Data outputs from the process controlling computer 64 are also supplied to the visual display monitor 54 and the printer 70 and 72 as diagrammed in Figure 24. A data communication modem 360 is provided to optionally interface the local computer 64 with a centrally controlled network of machines 10. Also, a door lock control 362 is provided as diagrammed in Figure 24.

Figure 25 illustrates in greater detail the interfacing between the local computer 64 and the various control components diagrammed in Figure 24. The input/output port 364 of the computer is interfaced through relay circuit section 366 and an operational control board 368 with various operational components of the machine. Toward that end, the control board 368 and relay section

366 are interconnected with each other through a data bus 370 through which a gripper control board 372 and an access port control board 374 are interfaced therewith. The port control board 374 controls operation of cassette drive motor 164 and the port shutter motor 138 as well as a cassette delivery indicator 376.

Feedback data is fed to the data bus 370 from reference position sensor circuits 378 and 380 in connection with the horizontal and vertical transport of the gripper, through terminals 382 and 384. Output data from the data bus 370 is fed to the door lock control 362 aforementioned and to a receipt cutter 386 associated with the receipt printer 72, through terminal 388.

Feedback data related to transport of the gripper toward and away from the storage assemblies or port unit 62 is derived from sensor circuits 390, 392 and 394 connected to the gripper control board 372. The sensor circuits 390 and 394 involve limit switches, such as switches 329 aforementioned, to detect the end of travel of the gripper device in the insert/withdrawal direction intersecting the common transport plane, while the sensor circuit 392 detects arrival of the gripper at the reference or zero position in such direction of travel. The feedback data from the sensor circuits 390, 392 and 394 is fed through the gripper control board 370 to the data bus 370.

The gripper control board 372 also supplies output data to control energization of motor reversing coils 396 and 398 for the gripper jaw motor 296 and to control energization of the drive motors 246 and 284 for effecting travel of the gripper in the

vertical transport direction and in the direction intersecting the transport plane, respectively. Energization of the drive motor 192 for effecting travel of the gripper in the horizontal transport direction is controlled directly through the motor controller 68 which is interfaced with the gripper control board 372 as shown. The motor controller 68 is connected to the motor control port 400 of the computer 64.

Decoder ports 402 and 404 of the computer 64 are connected to the scanner 338 and to a magnetic card reader 406 positioned in operative relation to the card slot 58 aforementioned in connection with Figures 1 and 2. Ports 408 and 410 connected to modem 360 and journal printer 70 establish the link and relationship necessary for operation of machine 10 as part of a network. Finally, the data transfer ports 412, 414 and 416 of computer 64 are connected to the receipt printer 72, the keypad 56 and the video monitor 54 as shown.

A typical network of machines 10 is diagrammed in Figure 26, wherein each of a plurality of machines 10 is coupled through its computer modem 360 and a communication link 418, such as a telephone or data line, with a communication modem 240 associated with a central host computer 422. Customer reservation data is fed to the host computer from customer terminals 424 through a telephone network 426 connected to modem 420. A data network 428 couples the host computer through its modem 420 to data terminals located on the premises of cassette suppliers and banks, for example, associated with the cassette merchandising system formed

by the network of machines 10 under joint control of their local computers 64 and the host computer 422 remote therefrom.

The local computer 64 of each machine 10 is programmed to carry out the various merchandising functions associated therewith, based on the arrangement of mechanical and electrical components hereinbefore described. As part of a network system, computer 64 is operated as a slave terminal dominated by the central host computer 422 to control rent, return and purchase transactions through its machine 10 as well as other functions such as financial collection and processing transactions, credit verification and status, inventory, maintenance and recovery operations. Some of the host computer functions are incorporated in the software for the local computer 64 so that the machine 10 may be operated as a stand alone unit.

The machine 10 is activated through its local computer 64 as denoted at 432 in the program flow chart of Figure 27, by insertion of a magnetic credit card through slot 58 into the reader 406 resulting in a step-by-step instructional display function 434 on the screen of the video monitor 54. Article selection is then made by the user from the information on the posters 52 as shown in Figures 1 and 2. A credit card reading function 436 is then performed as shown in Figure 27. If the credit card is validated, the software function 438 enables the keypad 56 so that the user may enter a selection code command through the number digit keys 440, as shown in Figure 28, and one of the transaction keys 442, 444 and 446. When the selection

command is properly entered as indicated at 448 in Figure 27, a transaction contract is displayed on the video monitor so that the user may then actuate the enter key 450 on the keypad to verify the contract as denoted by reference numeral 452 in Figure 27 to continue machine operation in a rental mode. The robotic transporter then undergoes an operational process 454, on command of the central system hereinbefore described, to deliver the selected article to the access port 62. The operational transport process involves computation of the distances between the access port and the storage zones holding the selected articles so as to select the nearest available selected article zone to provide the shortest operational time for the transport process. Upon completion of the transport process, the presence of the selected article in the access port is detected by its sensor as denoted by 456 in Figure 27 to continue the rental process to a conclusion by effecting the recording step 458 in parallel with a storage data update 460 followed by receipt print-out 462.

The programmed purchase process is similar to that of the rental process described except for the content of the receipt print-out and transaction recording. In the case of a rental operation, an open transaction record is made, including registration of the credit card number, article identification code number, date and time, and provision for closing the transaction without charge to the customer within a preprogrammed time span. Thus, such recording process is terminated to close the transaction in an overdue rental situation. In the case of a purchase

operation, the transaction recording process is closed to begin with.

The open transaction recording process is, of course, closed by timely start of a return mode of operation as also denoted in Figure 27, when insertion of the article into the access port 62 by the customer is detected as step 464 of the program following actuation of the return key 442 on the keypad. The access port is then closed by its shutter and the gripper is moved to the scanning position for reading of the ID bar code on strip 16 by means of scanner 338 as hereinbefore described. When the bar code ID is verified as denoted at 466, the article is clamped by the gripper for transport to the closest empty storage zone 98 in a return transport process denoted by 468 in Figure 27. The return status of the accepted article is computed at the same time and recorded as indicated at 470 followed by print-out of receipt at 472. Also, upon completion of the return transport process 468, the computer memory is updated as indicated at 474.

The data recorded at the end of closed transactions at each machine 10 of a network as hereinbefore described, is periodically transferred to the central host computer 422 on demand. Otherwise, such data may be periodically withdrawn manually from the journal printer 70. The software for the local computer 64 will also include service modes to enable servicing, maintenance, unloading and reloading of articles. The service modes are initiated by insertion of a service card in the magnetic card reader through slot 58 and entry of a service code through the

keypad 56. According to one code-identified service category, repair duties may be performed. According to another service mode category, only service operations are permitted, such as article loading and unloading, printer paper replacement and exchange of display posters 56.

The programs associated with the transport processes 454 and 468 diagrammed in Figure 27, are shown in the flow chart diagram of Figure 29. The transport program is initiated on command denoted by start 476 with article detection in the gripper as denoted by 478. If there is an article in the gripper, a transport process 480 is initiated, similar to the process to be described, for delivery of the article to the discard zone 100. The transport process program continues if there is no article in the gripper with the detection at 482 of an article (either in the port 62 or a selected storage zone 98, depending on the transport mode). If there is no article present (in port 62 or the selected storage zone), machine shut-down 484 occurs. The transport program continues with detection at 486 as to whether or not the gripper jaws are open. If the gripper is open, shut-down occurs; if closed, the program continues with the opening of the gripper on command at 488. When the open condition of the gripper is detected at 490, the transport process continues either with a rent mode start 492 or a return mode start 494 depending on the mode selection made through the keypad 56 as aforementioned. The transport program is completed in the rent mode as diagrammed in Figure 30 or in the return mode as diagrammed in Figure 31.

As diagrammed in Figures 27, 30 and 31, error processes 496 occur in response to signals which may be generated by the collision signalling device 320, hereinbefore described, during the transport processes. The programmed error process as diagrammed in Figure 32, begins with the error signal start 498 to enable a self-diagnostic system 500 through which a recovery process begins at start 502 and an error message recorded at a history file 504 in the computer memory. The recovery process according to one embodiment hereinbefore described, involves a transport operation 506 to the re-aligning zone 99 followed by a second transport operation to either the port 62 or another storage zone 98. If another collision occurs to generate a second signal denoted at 510 in Figure 32, transport 484 to the discard zone 100 is initiated after which shut-down occurs and a report is produced.

Figure 33 diagrams the operational procedure accommodated by the mechanical and control arrangements and the software programs hereinbefore described for performing the article loading and unloading service functions with respect to machine 10. Insertion, reading and verification of a magnetic service card initiates the service mode involved as denoted at 512 to either automatically perform the unload/load function one-by-one or in groups as denoted by 514, or enable manual unload/load by unlocking the doors through control 362 aforementioned, as denoted by 516.

The automatic unload/load operation 518 follows entry of the single article command from 514 as shown in Figure 33, involving the article selection step 520, transport step 522 and

inventory update 524. Automatic load involves the transport step 526. In the case of a group unload/load function, a manual operation 528 is enabled. For unloading purposes, an ordered group selection is entered as indicated at 530 to trigger an automatic one-by-one sequential unloading operation 532 with respect to the articles of the selected group, followed by inventory update 524. Loading under the manual mode 528 unlocks the doors of the machine to permit manual loading or unloading as indicated at 534 after which a door closing and locking operation 536 is manually performed. When the doors are locked, an automatic scanning operation 538 is triggered to provide data for the inventory update 524. Entry of update data is recorded for report 540 and registered through the visual display 434.

The machine 10 shown in Figure 34 has an outer cabinet structure generally referred to by reference numeral 24 formed by an intermediate housing portion 26 supported on a base portion 28 having level adjusted feet 30 as shown in Figure 1. The top of the cabinet structure is closed by a roof portion 32. While the base portion 28 is substantially rectangular, the top portion 32 is generally L-shaped to accommodate two front door assemblies 34 and 36. In the closed positions of the door assemblies, the front door panels 38 and 40 thereof are substantially flush with the front panel 42 closing a control compartment 44 on the right side within the cabinet as viewed in Figure 2. The door assemblies 34 and 36, themselves substantially seal a common travel or transport compartment 46 within the cabinet. The left hand door assembly 34

is pivotally mounted by a hinge 36 48 on the left end of the intermediate housing portion of the cabinet while the door 36 is pivotally mounted by the base and roof portions 28 and 32 of the cabinet along hinge axis 50 so that both door assemblies swing open in clockwise directions as shown in Figure 2 to expose the travel compartment 46. The travel compartment may also be opened to expose internal components of the machine for servicing purposes by opening of two rear panel doors 51 and 52.

The front panels 38 and 40 of the door assemblies have forwardly projecting sections mounting a plurality of posters 52 displaying information on the contents of the video cassettes available for rental or purchase. The front panel 42 closing the control compartment 44 at the right side of the cabinet mounts the screen of a visual display monitor 54 through which instructional data and other information is displayed to the user or servicing personnel. A keypad 56 is disposed below the visual display 54 for entry of operational mode selection data and code identifying data as will be described hereinafter. Machine enabling inputs are entered by insertion into a vertical slot 58 of credit or service identification cards containing magnetically readable validating data. A printed receipt delivery port 60 is mounted on the panel 42 below the keypad 56 and card slot 58. A transaction access port 62 is mounted on the front panel 40 of the door assembly 36 below the display posters 52.

The control compartment 44 of the cabinet encloses the visual display monitor 54 which is electronically connected to a

programmed computer control system 64 as disclosed in the prior copending application aforementioned, to which the keypad 56 is connected. The computer control system includes a computer and a motor controller to which the computer is electrically connected. The control compartment also houses a journal printer to record transactions performed by the machine 10 and a receipt printer through which transaction receipts are imprinted under control of the computer system 64. Severed print-out receipts are ejected by the receipt printer into the receipt delivery port 60 aforementioned.

As shown in Figure 36, the receipt delivery port 60 is exposed through its opening in plate 82 above an opening 84 of an additional port fixedly mounted by the cabinet in alignment with the upper end of an emergency port chute 86 extending downwardly at an angle into the upper end of an emergency return storage bin 88. The emergency port opening 84 is shown normally closed by a door plate 90 connected by a crank pin operating linkage 92 to a drive motor 94. The motor 94 is energized to upwardly displace the door plate 90 to open the emergency port in an emergency return mode of operation as will be explained in detail hereinafter. A sensor 96 detects deposit of returned articles onto the chute 86 of the emergency return port.

The article access port 62, hereinbefore referred to, is substantially coplanar with the emergency port in the closed position of front door assembly 36 and projects inwardly from its front panel 40 through a section 78 of the transaction storage

facility mounted on the inside of door assembly 36. The storage section 78 is similar to the storage section 80 mounted on the other door 34 as shown in Figure 34, except for the extension of the port 62 therethrough into the travel compartment 46. The construction and arrangement of the storage sections 78 and 80 and cooperating components of the machine are described in detail in the aforementioned prior copending application.

When the cassette holder 14 is held in a data reading position, it is adapted to be returned to the transaction storage by a robotic transporter system generally referred to by reference numeral 190, located within the compartment 46 as shown in Figure 1 and described in detail in the aforementioned prior copending application. The transporter system as diagrammed in Figure 37, transports the articles held by the gripper 270 between the transaction storage 98 and access port 62. A malfunction signalling device 320 is associated with the gripper to register, for example, a collision caused by the erroneous delivery of an article to a storage zone already occupied. When an excessive resistance to movement of the gripper is experienced because of a collision, the collision error signal is generated. Also carried by the gripper device 270 is a bar code scanner 338 as diagrammed in Figure 5. The scanner is supported by the gripper closely spaced from the transaction storage 98 or port 62 for reading of the bar code on strip 16 of a cassette. The scanner 338 is retracted from its bar code reading position when the article is clamped to the gripper 270 for transport by robotic transporter 190

between locations aligned with the access port 62 and the transaction storage 98 which includes the storage zones in storage sections 78 and 80, a realignment zone and a disposal zone as disclosed in the aforementioned prior copending application. Such operations of the transporter 190 are under control of the programmed computer control system 64 which includes the computer and motion controller aforementioned. The control system receives inputs from its memory, from the identification scanner 338 and error recovery feedback 100 from the transport system 190 through the malfunction signal device 320. Inputs to the control system are also received from the keypad 56 for selection of the programmed operational mode of machine 10 as diagrammed in Figure 37. Data outputs from the control system 64 are supplied to the visual display monitor 54 and the printers as aforementioned.

In accordance with the present invention, the emergency return mode of operation aforementioned is initiated after transaction shutdown by code entry through the keypad 56, when the control system 64 is so enabled by malfunction error feedback 102 from the transport system 190, as diagrammed in Figure 37, reflecting repeated collisions preventing normal return mode of operation through the access port 62 despite ensuing error recovery actions. When the emergency return mode is initiated, the door operating section 90-94 opens the emergency port 84-86 so that the customer may deposit an article for return to the separate storage bin 88. The returned articles entering the emergency storage bin

88 are detected by sensor 96 to supply a signal to the control system 64 for completing the emergency return mode of operation and to register an increase in the count of the number of articles stored in storage bin 88 through counter 104. The total count from counter 104 is applied to the control system 64 so as to prevent subsequent initiation of an emergency return mode when a predetermined number of articles are accumulated in storage bin 88, representing its maximum capacity.

The operational capability of the computer control system 64 as diagrammed in Figure 37 is also enlarged in accordance with the present invention to accept an article identifying code input from the keypad 56 in the event the identification code scanner 338 fails to read the identifying code on an article placed by a customer into the access port 62 which ordinarily initiates a normal return mode of operation. Such return mode of operation is aborted by such reading failure of the scanner 338. Selective input of the identification code by the customer through the keypad 56 will accordingly resume such aborted return mode operation to complete the transaction in an otherwise normal fashion without resort to the emergency return mode operation aforementioned.

The machine 10 is activated through its computer control system 64 as denoted at 432 in the program flow chart of Figure 38, by insertion of a magnetic credit card through slot 58 resulting in a step-by-step instructional display function 434 on the screen of the video monitor 54. Article selection is then made by the user from the information on the posters 52 as shown in Figure 1.

A credit card reading function 436 is then performed as shown in Figure 38. If the credit card is validated, the software function 438 enables the keypad 56 so that the user may enter selection code commands as denoted at 440. Rental or purchase modes may be initiated on command as described in detail in the aforementioned prior copending application.

A return mode of operation is initiated pursuant to instruction display 442 by insertion of the article into the access port 62 as detected in step 464 of the program, following coded command from the keypad. The access port is then closed by its shutter and the gripper is moved to the scanning position for reading of the ID bar code on strip 16 by means of scanner 338 as aforementioned. When the bar code ID is verified as denoted at 466, the article is clamped by the gripper for transport to the closest empty storage zone of transaction storage 98 in a return transport process program denoted by 468 in Figure 38. The return status of the accepted article is computed at the same time and recorded as indicated at 470 followed by print-out of a receipt at 472. Also, upon completion of the return transport process 468, the computer memory is updated as indicated at 474.

As diagrammed in Figure 38, a recovery process program 496 may be initiated in response to signals generated by the aforementioned collision signalling device 320 during the transport processes. If the recovery process is unsuccessful, then an emergency return process program 498 follows. The programmed recovery process as diagrammed in Figure 39 begins with a recovery

process start 500 in response to a collision signal. A command is then generated in the computer control system to maintain the gripper in its open or closed condition existing prior to collision as denoted at 502 followed by transporter reset operation 504. If the transporter thereby displaces the gripper to the zero reset position as indicated at decision block 506 in Figure 39, and an article is present in the gripper as denoted at decision block 508, a transport realignment operation 510 ensues followed by a scanning operation 512 to read the identification code on the article in the alignment cell. If the ID code is recognized at 514, the article is transported to one of the zones in the transaction storage as indicated at 516. Otherwise the article is transported to the discard zone as indicated at 518 in Figure 39.

If the recovery process as diagrammed in Figures 6 and 7 is unsuccessful in connection with the normal or modified normal return mode, the emergency return process is enabled as diagrammed in Figure 38. The emergency return mode program as diagrammed in Figure 40 is initiated at start 520 by user insertion of a credit card into slot 58 resulting in card reading operation 522. If the card is verified at decision block 524, the emergency port 84-86 is opened by operation 526 of the door motor 94 enabled at 528 by the control system following an unsuccessful recovery process 496, as aforementioned, accompanied by transaction shutdown display 530 and receipt issuance 532, as well as an error input 534 to the computer memory.

Upon opening of the emergency return port, an instruction display 536 is produced as diagrammed in Figure 40, pursuant to which an article is inserted into the open port producing a count operation 538 and display 540 of instructions to enter the article ID code through the keypad 56. Also, if the count total ($A_n$) is equal to or less than the limit value ($A_l$), as denoted in decision block 542, keypad entry is transmitted at 544 to continue with the emergency return program. Otherwise, the emergency return program is aborted as indicated at 546 and the recovery process program 496 initiated again.

The emergency return program is resumed or continued if the emergency port is open as denoted at decision block 548 by counting of the inserted article. If the counting operation is successful, as denoted in decision block 550, a port closing operation 552 is initiated. Otherwise, the condition of the port is monitored after a 5 second delay 554 to determine at 556 if the port is closed. If the port is open, the process is aborted. If the port is closed following the closing operation 552 during continued emergency return operation as determined at 558, completion of the emergency return process is reflected by issuance of a receipt as indicated at 560 in Figure 40 and the count is updated as denoted at 562.

The foregoing is considered as illustrative only of the principles of the invention. Further since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and

operation shown and described, and, accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

WHAT IS CLAIMED IS: 45

1. In a machine for storing, dispensing and receiving articles, including a cabinet, article storage means enclosed within the cabinet, a port in said cabinet through which the articles are delivered and returned, drive engaging means operatively mounted in the port for displacement of the articles therein between at least two positions, scanner means for identifying the articles in the port at one of the said positions therein, gripper means for clamping thereto the articles within the storage means and the port and robotic transport means connected to the gripper means for travel of the clamped articles between the port and the storage means.

2. The combination of claim 1 wherein said cabinet includes a travel compartment within which the robotic transport means is enclosed, at least one door assembly within which the storage means is mounted and means pivotally mounting the door assembly for displacement between an open position and a closed position substantially sealing the travel compartment.

3. The combination of claim 2 wherein said port is mounted by the door assembly and extends through the storage means into the travel compartment in the closed position of the door assembly.

4. The combination of claim 3 wherein said storage means include article support means for establishing a plurality of separate storage zones respectively receiving the articles operatively oriented relative thereto and realigning means mounted

within one of the said storage zones for engagement with the articles inserted therein to restore said operative orientation.

5. The combination of claim 4 wherein said storage means further includes a discard zone.

6. The combination of claim 5 wherein said robotic transport means includes drive means for imparting motion to the gripper means in horizontal and vertical transport directions in a common transport plane within the travel compartment between locations aligned with the port and said zones of the storage means and additional drive means for retraction and insertion of the articles clamped in the gripper means in a third direction intersecting said transport plane.

7. The combination of claim 6 including means for generating a signal in response to interruption in motion imparted to the gripper means in said third direction during insertion of the articles into one of the storage zones.

8. The combination of claim 7 including programmed control means operatively connected to the drive means of the robotic transport means and responsive to said signal for continued travel of the gripper means and insertion of the articles clamped thereto into the realigning means and subsequent travel and insertion into another of the storage zones in the absence of a second signal from the signal generating means.

9. The combination of claim 8 wherein said programmed control means effects continued travel and deposit of the articles in the discard zone in response to the second signal.

10. The combination of claim 9 wherein said drive means includes a pair of drive shafts rotatably mounted within the travel compartment about fixed axes parallel spaced along said horizontal transport direction, track means in driving engagement with said drive shafts for displacement of the gripper means along said horizontal transport direction, and drive connecting means between said drive shafts for simultaneous rotation thereof at equal speeds.

11. The combination of claim 10 wherein said track means includes a horizontal track device slidably mounting the gripper means for guiding displacement thereof along said third direction by the additional drive means and a vertical track device for slidably guiding displacement of the horizontal track device along the vertical transport direction by the drive means.

12. The combination of claim 11 including means mounting the scanner means on the gripper means for limited displacement relative thereto.

13. The combination of claim 12 including abutment means mounted by the horizontal track device for engagement with the scanner mounting means in an article clamping position of the gripper means at one of the aligned locations within the travel compartment causing said limited displacement of the scanner means from a scanning position.

14. The combination of claim 13 wherein said port includes an elongated guide member within which the articles are received and shutter means mounted on the guide member for

displacement between open and closed positions respectively admitting and blocking insertion therein of the articles, and spring biased means mounting the drive engaging means on the guide member for projection into driving engagement with the articles inserted therein.

15. The combination of claim 14 wherein the gripper means includes a body on which the scanner means is carried, a lower jaw fixed to the body and projecting forwardly therefrom in said third direction, a movable jaw pivotally mounted on the body above the lower jaw, spring means for biasing the movable jaw to a clamping position and powered actuator means for displacement of the movable jaw from said clamping position under control of the programmed control means.

16. The combination of claim 15 including holders within which said articles are retained during delivery and return, respectively, each of said holders having openings through which coded indicia on the article is exposed to the scanner means and a surface portion engaged by the drive engaging means.

17. In a machine for storing, dispensing and receiving articles, including a cabinet enclosing a travel compartment, at least one door assembly, means pivotally mounting the door assembly on the cabinet for displacement between an open access position and a closed position substantially sealing the travel compartment, storage means within the door assembly for storing the articles therein, an article access port mounted by the door assembly and

extending through the storage means into the travel compartment in the closed position of the door assembly and robotic transport means within the travel compartment for movement or the articles between the port and the storage means.

18. The combination of claim 17 wherein said storage means includes article support means for establishing a plurality of separate storage zones respectively receiving the articles operatively orientated relative thereto and realigning means mounted within one of said storage zones for engagement with the articles inserted therein to reestablish said operative orientation.

19. The combination of claim 18 wherein said storage means further includes a discard reception zone.

20. The combination of claim 19 wherein said port includes an elongated guide within which the articles are received and shutter means mounted on the guide for displacement between open and closed positions respectively admitting and blocking delivery and return of the articles through the guide.

21. The combination of claim 17 wherein said port includes an elongated guide within which the articles are received and shutter means mounted on the guide for displacement between open and closed positions respectively admitting and blocking delivery and return of the articles through the guide.

22. In a machine for storing, dispensing and receiving articles, including storage means for establishing a plurality of separate storage zones respectively receiving the articles

operatively orientated relative thereto and a discard zone, re-aligning means mounted within one of the storage zones for engagement with the articles inserted therein to restore the operative alignment, a port through which the articles are delivered and returned, robotic means for transporting the articles between the port and the storage means, means responsive to interrupted insertion of the articles into one of the storage zones by the robotic means for generating a signal and programmed control means operatively connected to the robotic means and responsive to said signal for transport to and insertion of the articles into the re-aligning means followed by travel and insertion into another of the storage zones in the absence of a second signal from the signal generating means.

23. The combination of claim 8 wherein said programmed control means effects continued travel and deposit of the articles in the discard zone in response to the second signal.

24. In a machine for storing, dispensing and receiving articles, including a cabinet, article storage means enclosed within the cabinet, a port in said cabinet through which the articles are delivered and returned, drive engaging means operatively mounted in the port for displacement of the articles therein between at least two positions, scanner means for identifying the articles in the port at one of the said positions therein, robotic means for transporting the articles between the port and the storage means and holders within which said articles are retained during said delivery and return, respectively, each

of said holders having an opening through which coded indicia on the article is exposed to the scanner means and a surface portion engaged by the drive engaging means.

25. In a machine for storing, dispensing and receiving articles, including means for storing the articles, a port through which the articles are delivered and returned, scanner means for identifying the articles received in the port, robotic means for transport of the articles between the port and the article storing means, gripper means carried by the robotic means for releasably holding the articles during transport between the port and the storage means, means mounting the scanner means on the gripper means for limited displacement relative thereto, and abutment means on the robotic means for engagement with the scanner mounting means causing said limited displacement thereof from a scanning position during engagement of the article by the gripper means.

26. The combination of claim 25 wherein the gripper means includes a body on which the scanner means is carried, a lower jaw fixed to the body, a movable jaw pivotally mounted on the body, spring means for biasing the movable jaw to a clamping position and powered actuator means for displacement of the movable jaw from said clamping position.

27. The combination of claim 25 wherein said robotic means includes first track means slidably mounting the gripper means for displacement in one direction during insertion into and retrieval of the articles from the article storing means, second and third track means slidably mounting the first track means for

displacement thereof in perpendicular transport directions between the port and the article storing means and drive means operatively connected to the gripper means and the first and second track means for imparting motion to the gripper means along said one direction and said transport directions.

28. The combination of claim 27 wherein said drive means include a pair of spaced drive shafts rotatably mounted about fixed axes parallel to one of said transport directions, screw means drivingly connecting said drive shafts to the second track means for displacement thereof along said one of the transport directions and drive connecting means operatively interconnecting the drive shafts for simultaneous rotation at equal speeds.

29. In combination with a machine having powered means for transporting products between storage and access locations, code reading means for generating operational enabling data, a keyboard from which mode operational data is derived, sensor means monitoring operation of the powered transporting means for generating motion control data and motor means connected to the powered transporting means for operation thereof, a control system including a local computer, a remote computer, terminal means connecting said computers to the motor means for operation of the transport means in response to entry of said data and mode selection means connected to the terminal means for programming said operation of the transport means either under exclusive control of the local computer or under joint control of both of the computers.

30. In combination with a gripper and robotic transport means for displacing the gripper in a common transport plane between predetermined locations and in a direction intersecting said plane at said locations, lost-motion coupling means operatively connected to the robotic transport means for accommodating relative displacement between the gripper and the transport means in response to excessive resistance to movement of the gripper in said direction intersecting the common transport plane and means responsive to said relative displacement for generating a signal indicating collision of the gripper.

31. The combination of claim 30 wherein the transport means includes a rotatable screw shaft, a nut engaged with the screw shaft and means connecting the lost-motion coupling means to the nut for preventing rotation thereof to confine movement thereof in said direction intersecting the common transport plane.

32. The combination of claim 31 including a data reading scanner mounted on the gripper in a scanning position, control means operatively connected to the gripper for displacement thereof along said direction intersecting the common transport plane to reading and gripping positions and means for retracting the scanner from said scanning position thereof in response to displacement of the gripper to the gripping position.

33. The combination of claim 30 including a data reading scanner mounted on the gripper in a scanning position, control means operatively connected to the gripper for displacement thereof along said direction intersecting the common transport plane to

reading and gripping positions and means for retracting the scanner from said scanning position thereof in response to displacement of the gripper to the gripping position.

34. In a machine for storing, dispensing and returning articles, including means for storing the articles, a transaction port through which the articles are delivered and returned, a scanner, robotic means for transport of the articles between the transaction port and the article storing means during an operational mode, gripper means carried by the robotic means for releasably holding the articles during said transport between the transaction port and the storage means, means mounting the scanner on the gripper means for limited displacement thereon to identify the articles within the transaction port and the storing means, means responsive to failure of the scanner to identify the articles for aborting operation of the robotic means during said operational mode thereof, a keyboard and means responsive to selective entry through the keyboard of identifying data corresponding to the articles in the transaction port for resuming the aborted operation of the robotic means.

35. The combination of claim 34 including additional storage means for separately storing the returned articles and means selectively enabled through the keyboard for accepting return of the articles to the additional storage means in response to transaction shutdown of the robotic means.

36. In a machine for storing, dispensing and returning articles, including means for storing the articles, a transaction

port through which the articles are delivered and returned, scanner means for identifying the articles within the transaction port during an operational transaction mode, gripper means carried by the robotic means for releasably holding the articles during transport between the transaction port and the storage means, additional storage means for separately storing the returned articles during transaction shutdown, a keyboard and means selectively enabled through the keyboard for accepting return of the articles to the additional storage means in response to said transaction shutdown.

37. In a machine for storing, dispensing and receiving articles, including a transaction port through which said articles are delivered and returned during normal delivery and return modes, transaction storage means within which the articles are received from said transaction port in the normal return mode, robotic means for transporting the articles between the storage means and the transaction port in said normal modes, detection means responsive to malfunction of the robotic means during said normal modes for generating error signals and programmed control means responsive to said error signals for operating the robotic means in a recovery mode tending to restore operation of the robotic means to said normal modes, the improvement residing in handling return of the articles in an emergency return mode, including emergency storing means separate from the transaction storage means for receiving the articles and selectively controlled means enabled by failure to restore operation to said normal return mode for accepting said

return of the articles during the emergency return mode to the emergency storing means.

38. The improvement as defined in claim 37 including means for detecting and counting the articles returned to the emergency storing means and operational limiting means operatively connected to the detecting and counting means for preventing said acceptance of returned articles in said emergency return mode in response to storage of a predetermined number of the articles within the emergency storing means.

39. The improvement as defined in claim 38 wherein the emergency storing means includes an additional port through which the articles are returned during the emergency return mode and power operated door means for controlling opening of the emergency storing means through the additional port.

40. The combination of claim 39 including scanner means for identifying the articles in the transaction port.

41. The improvement as defined in claim 40 including means responsive to failure of the scanner means to identify the articles in the transaction port for aborting the normal return mode of operation of the robotic means and means responsive to selective entry of identifying data corresponding to the articles in said transaction port for resuming the aborted operation of the robotic means in the normal return mode.

42. The improvement as defined in claim 37 wherein the emergency storing means includes an additional port through which the articles are returned during the emergency return mode and

power operated door means for controlling opening of the emergency storing means through the additional port.

43. The improvement as defined in claim 41 including scanner means for identifying the articles in the transaction port, means responsive to failure of the scanner means to identify the articles in the transaction port for aborting the normal return mode of operation of the robotic means and means responsive to selective entry of identifying data corresponding to the articles in said transaction port for resuming the aborted operation of the robotic means in the normal return mode.

44. The improvement as defined in claim 37 including a cabinet enclosing a travel compartment within which the robotic means is located, at least one front door assembly hingedly connected to the cabinet on which the transaction storage means and the transaction port are mounted for exposure to the travel compartment in a closed position thereof, and access door means mounted on the cabinet in rearwardly spaced relation to the front door assembly for selectively opening the travel compartment to expose the robotic means and the transaction storage means in the closed position of the front door assembly.

45. The improvement as defined in claim 44 wherein the emergency storing means includes an additional port fixedly mounted by the cabinet in substantially coplanar relation to the transaction port in the closed position of the front door assembly.

46. In a machine for storing, dispensing and receiving articles, including a port through which said articles are

delivered and returned during normal delivery and return modes, transaction storage means within which the articles are received from said port, robotic means for transporting the articles between the storage means and the port in said normal modes, scanner means for identifying the articles in the port, means responsive to failure of the scanner means to identify the articles in the port for aborting the normal return mode of operation of the robotic means and means responsive to selective entry of identifying data corresponding to the articles in said port for resuming the aborted operation of the robotic means in the normal return mode.

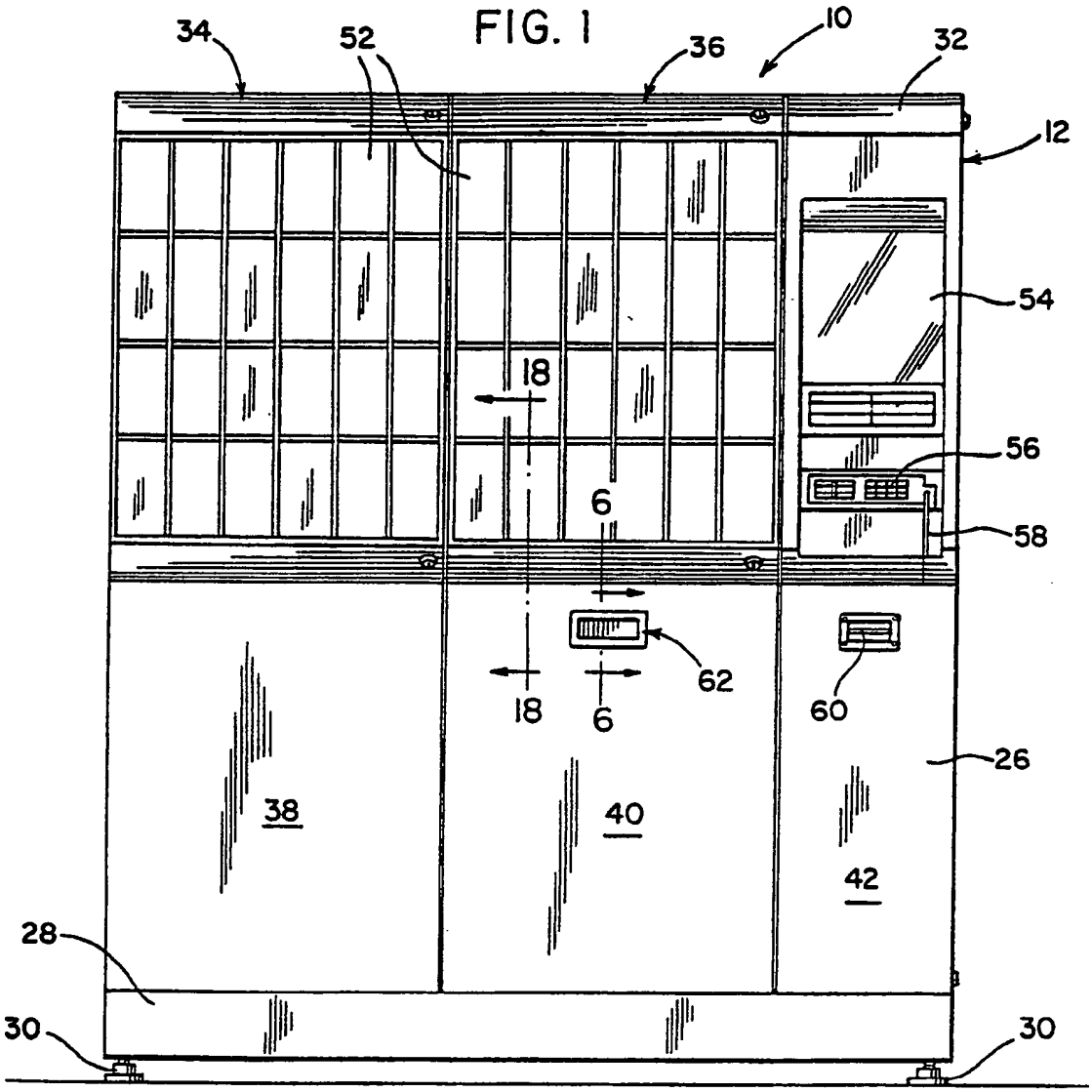
47. In combination with a machine having means for transport of products between storage and access locations, code reading means for generating operational enabling data, a keyboard, sensor means monitoring operation of the transport means for generating motion control data, a computer control system connecting the sensor means and the code reading means to the transport means for operation thereof in response to entry of said enabling data and the motion control data, mode selection means connecting the keyboard to the control system for programming said operation of the transport means, said control system including means responsive to failure of the code reading means to generate the enabling data for aborting the selectively programmed operation of the transport means and means responsive to selective entry of the enabling data from the keyboard through the mode selection means for resuming said aborted operation of the transport means.

48. In combination with a machine having means for transport of products between storage and access locations, code reading means for generating operational enabling data, a keyboard, sensor means monitoring operation of the transport means for generating motion control data, a computer control system connected to the sensor means and the code reading means for operation of the transport means in response to entry of said data, mode selection means connecting the keyboard to the control system for programming said operation of the transport means, emergency means for separately storing the products returned to the machine and means responsive to the motion control data generated by the sensor means reflecting malfunction of the transport means for disabling the transport means through the control system while enabling said return of the products to the emergency storing means.

49. In a vending machine including a cabinet enclosing a travel compartment having at least one front door assembly, means pivotally mounting the door assembly for displacement between an open position and a closed position substantially sealing the travel compartment, an access port mounted in the front door assembly and extending therefrom into the travel compartment, transaction storage means mounted by the front door assembly for exposure to the travel compartment, robotic transport means operatively mounted within the travel compartment for transporting articles between the access port and the transaction storage means, emergency port means fixedly mounted by the cabinet in substantially coplanar relation to the access port for accepting

return of the articles only during transaction shut-down of the robotic transport means and additional door means mounted by the cabinet in rearwardly spaced relation to the front door assembly for selective access to the travel compartment exposing the robotic transport means and the transaction storage means in the closed position of the front door assembly.

FIG. 1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12
54
18
56
6
58
62
18
6
60
26
38
40
42
28
30
30

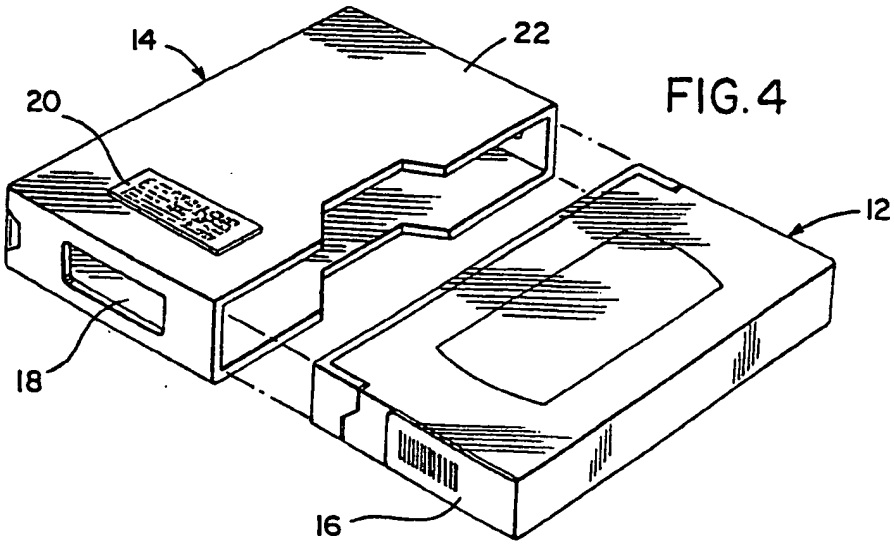

14
22
20
12
18
16

FIG. 4

FIG. 2

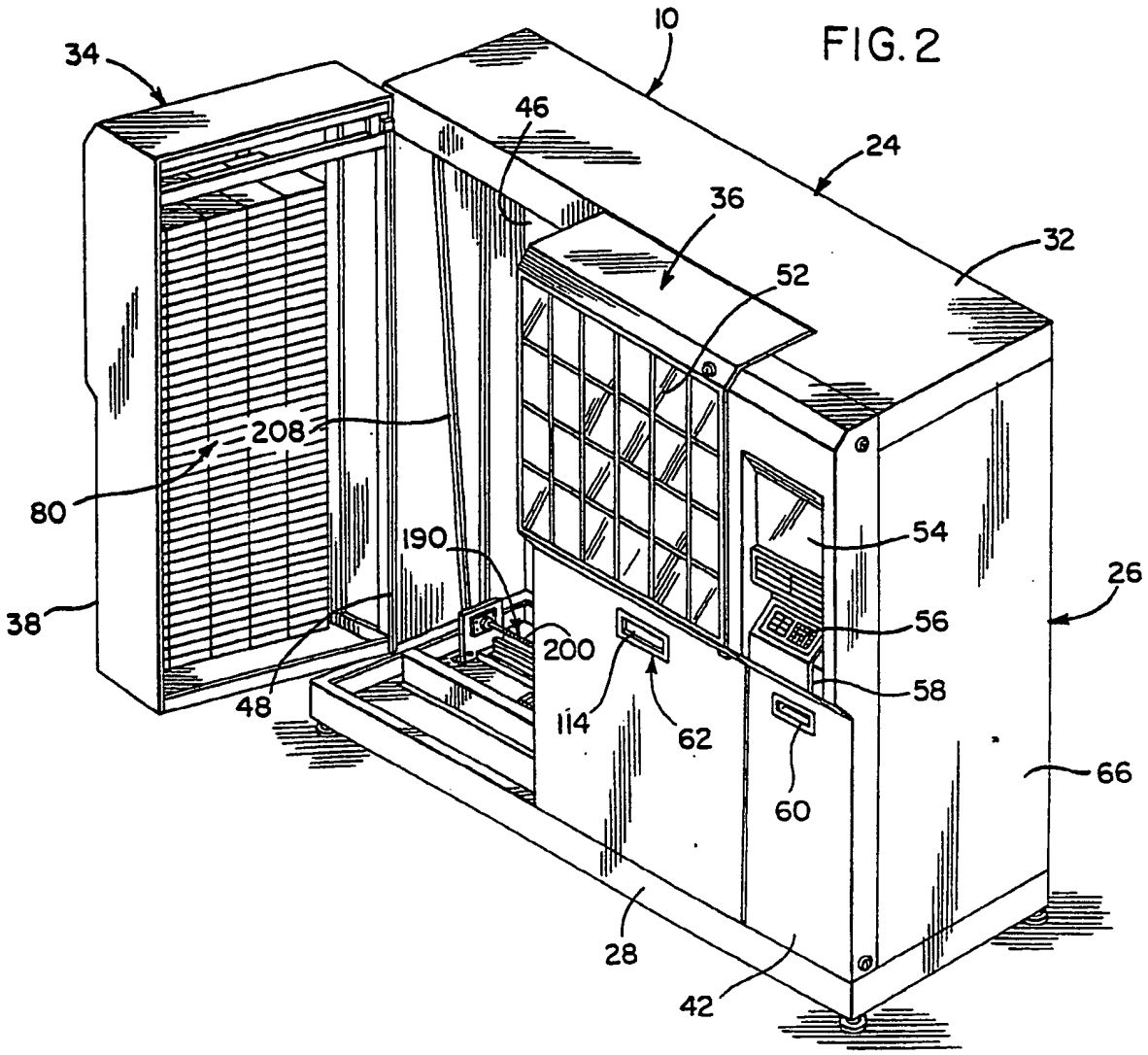
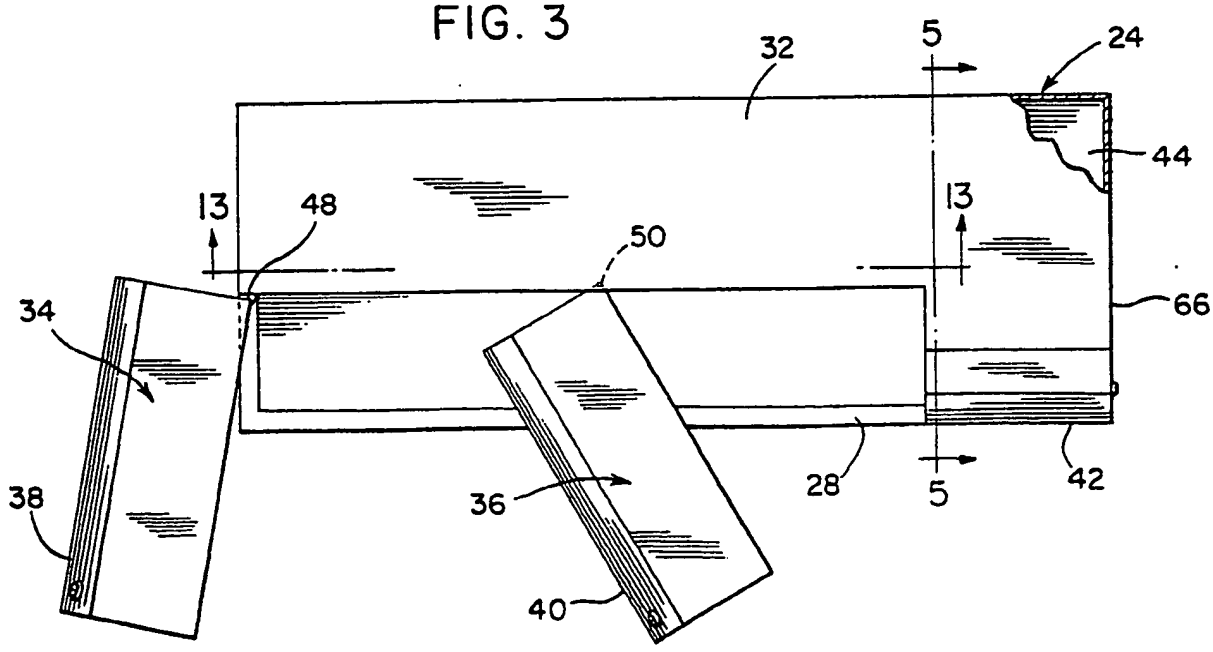

10
34
46
24
36
32
52
208
80
190
54
26
38
200
56
48
114
62
58
60
66
28
42

FIG. 3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5
24
44
13
48
50
13
66
34
38
36
28
5
42
40

FIG. 5

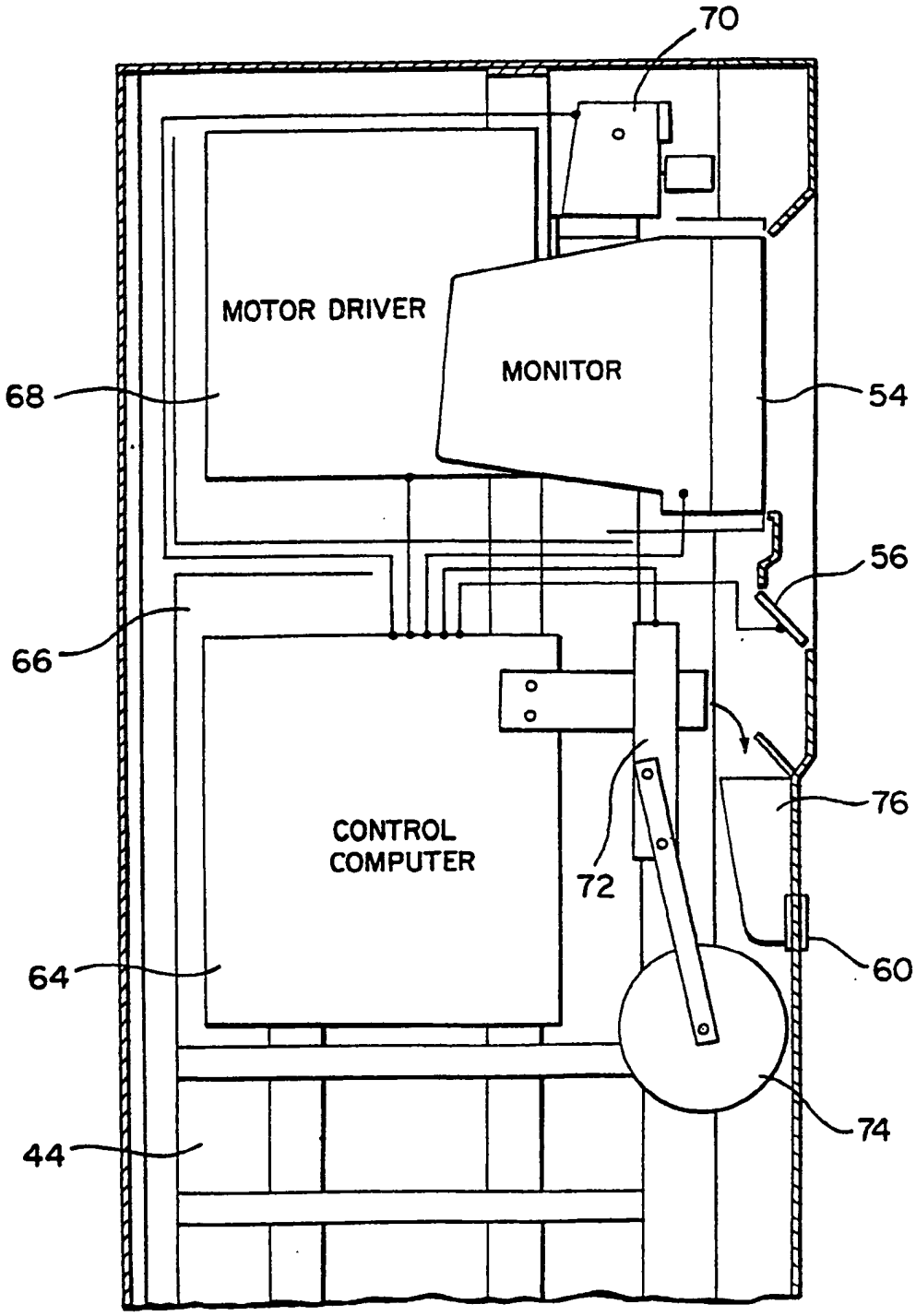

70
MOTOR DRIVER
MONITOR
68
54
56
66
CONTROL
COMPUTER
72
76
64
60
74
44

FIG. 6

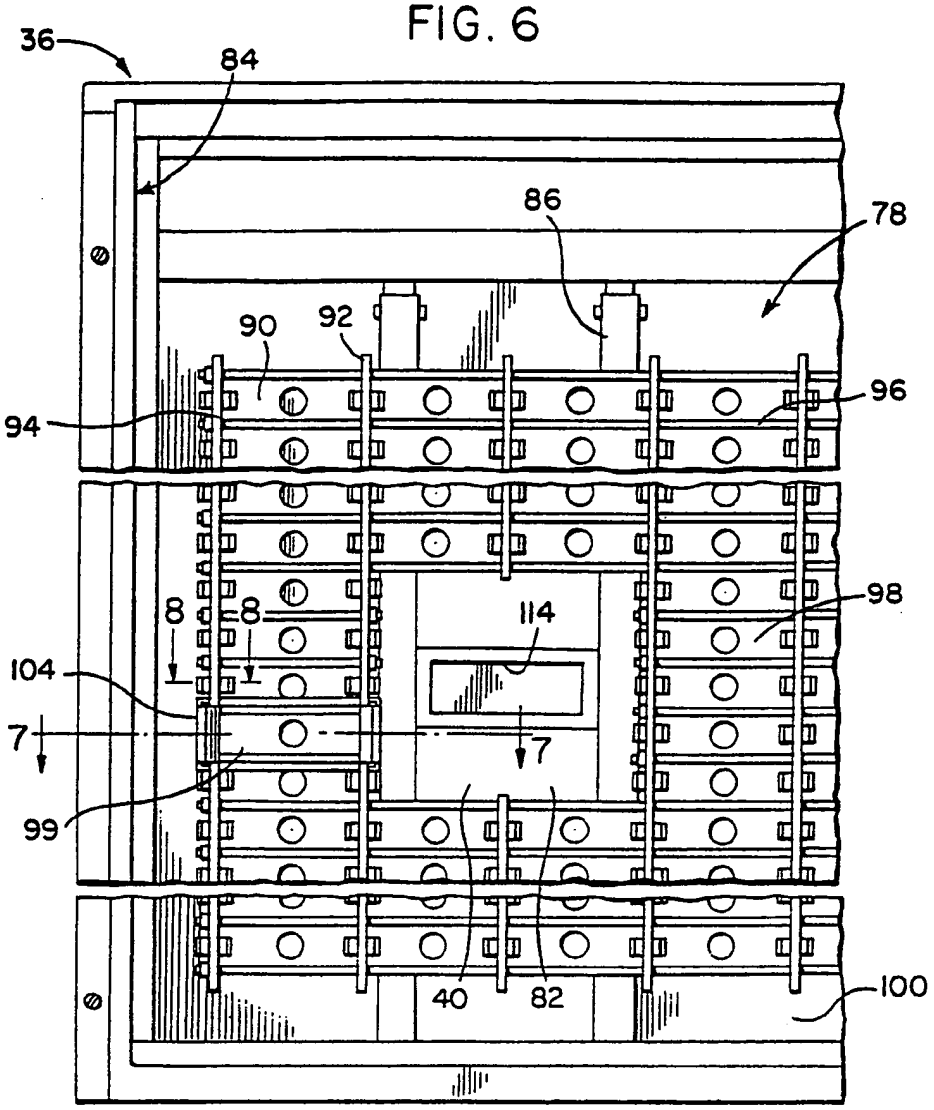



FIG. 7

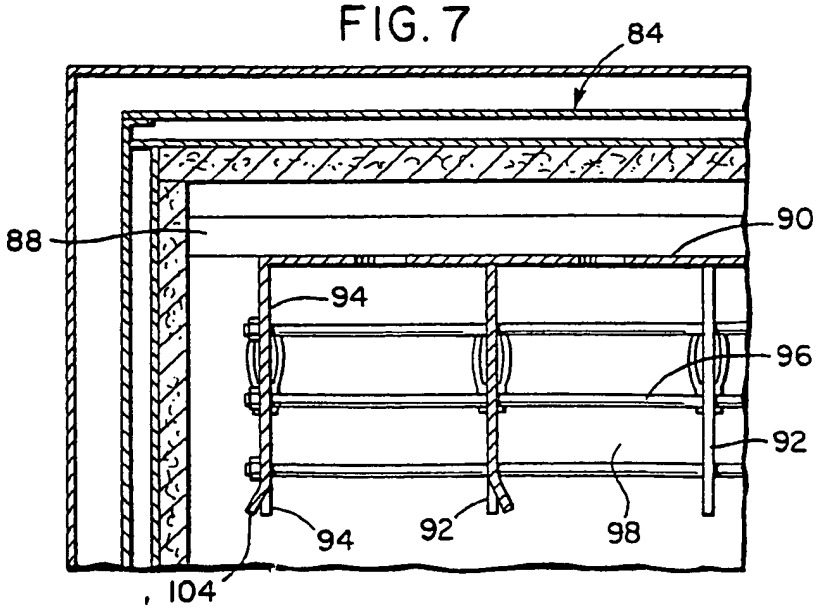
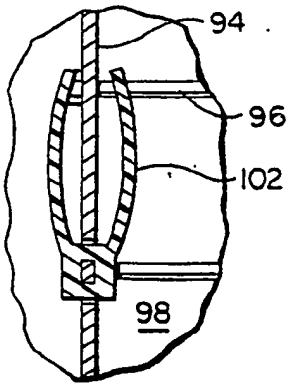
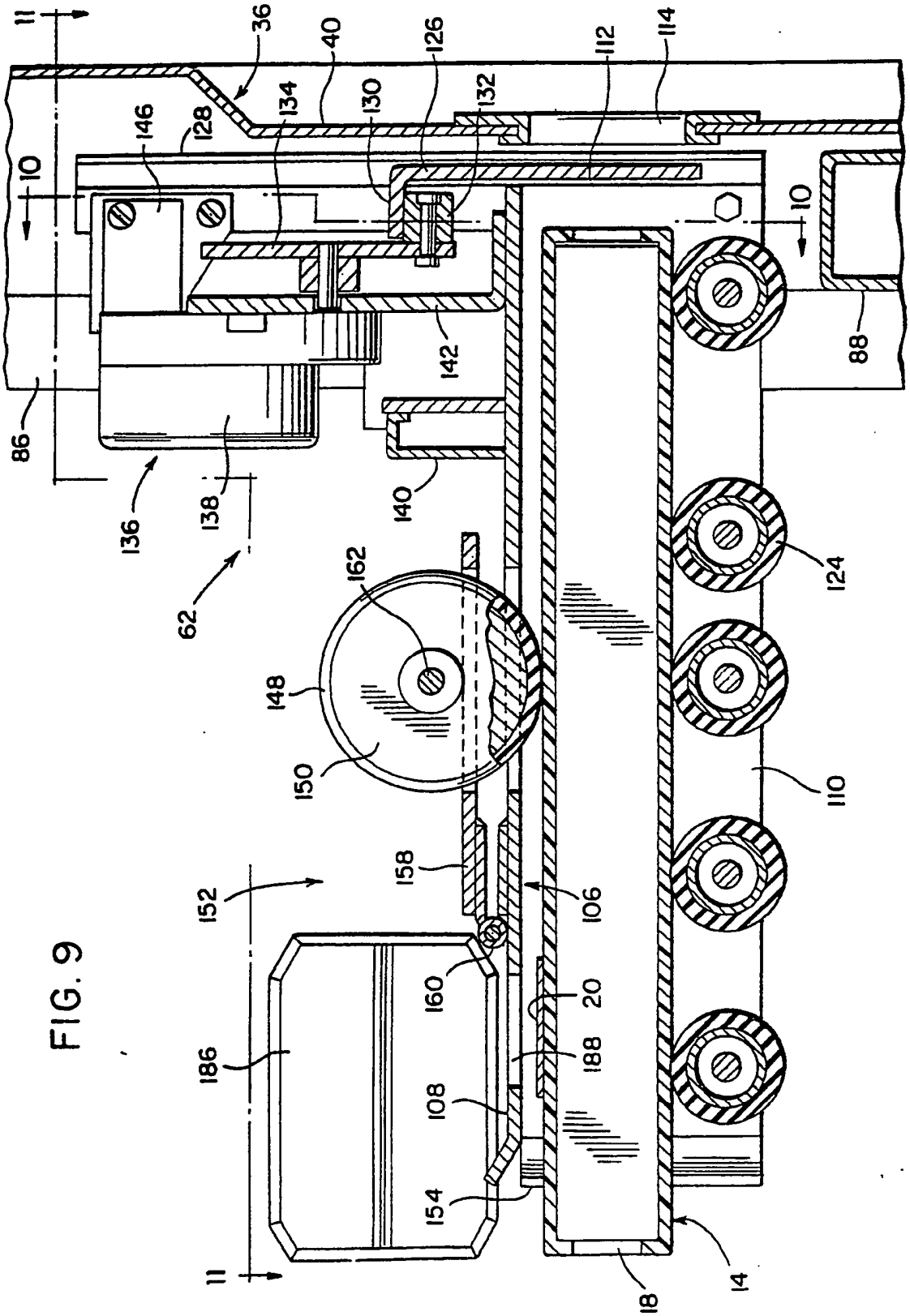



FIG. 8

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36
40
126
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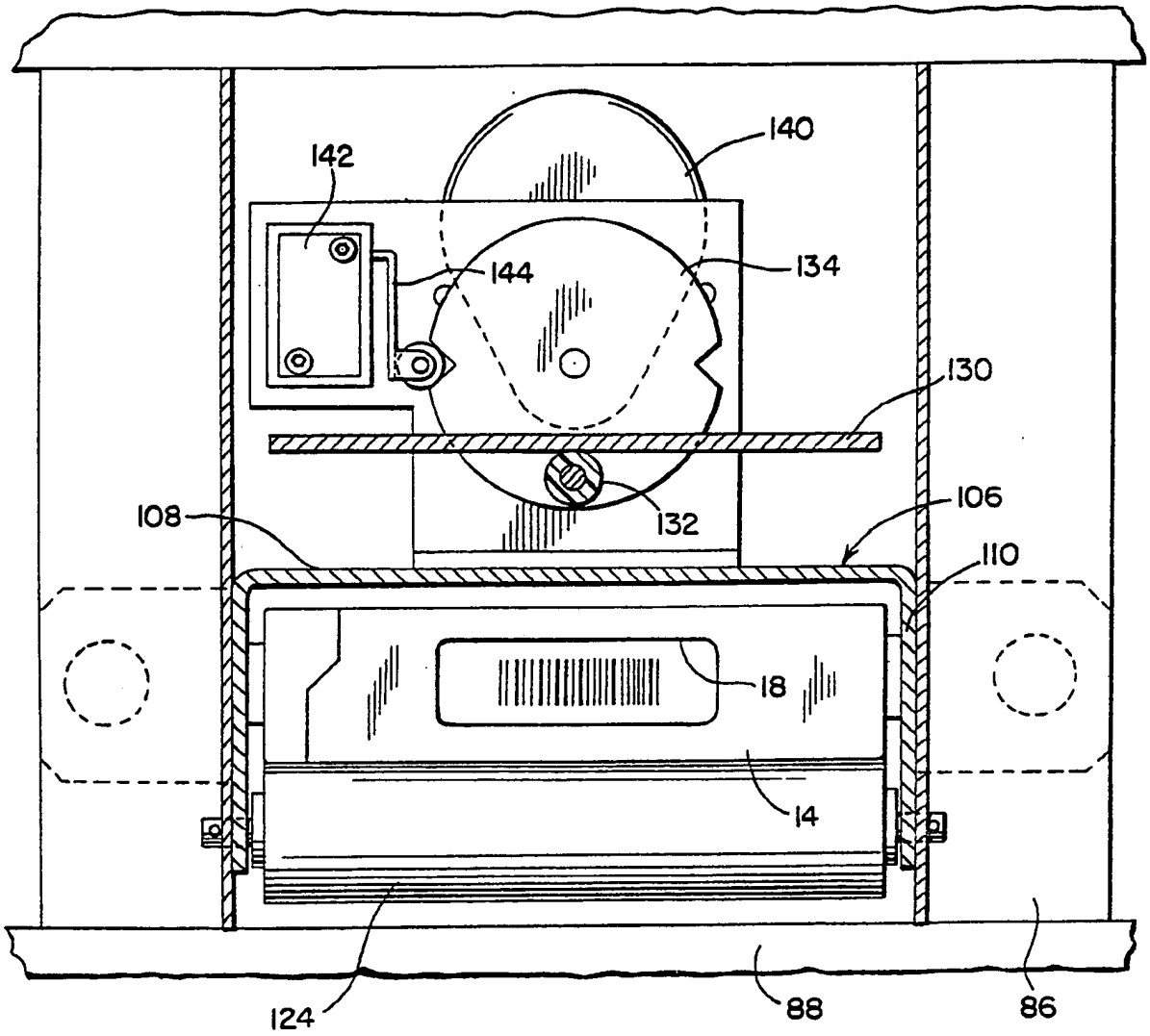
114
134
130
132
146
128
10
10
88
142
86
136
138
140
62
162
124
148
150
110
158
152
106
160
20
186
188
108
154
11
18
14

FIG. 9

FIG. 10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130
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108
106
110
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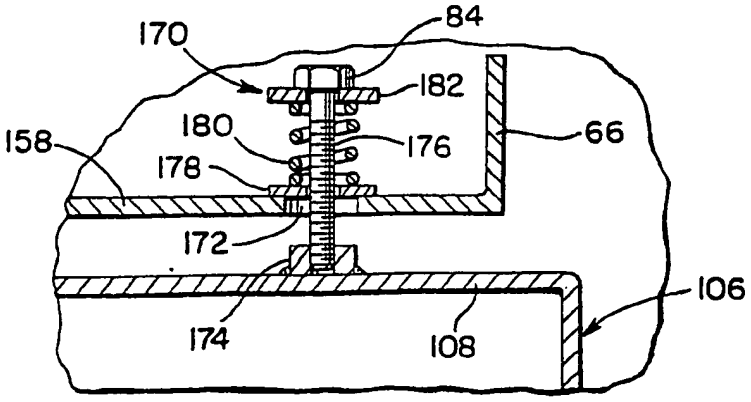
14
124
88
86

FIG. 12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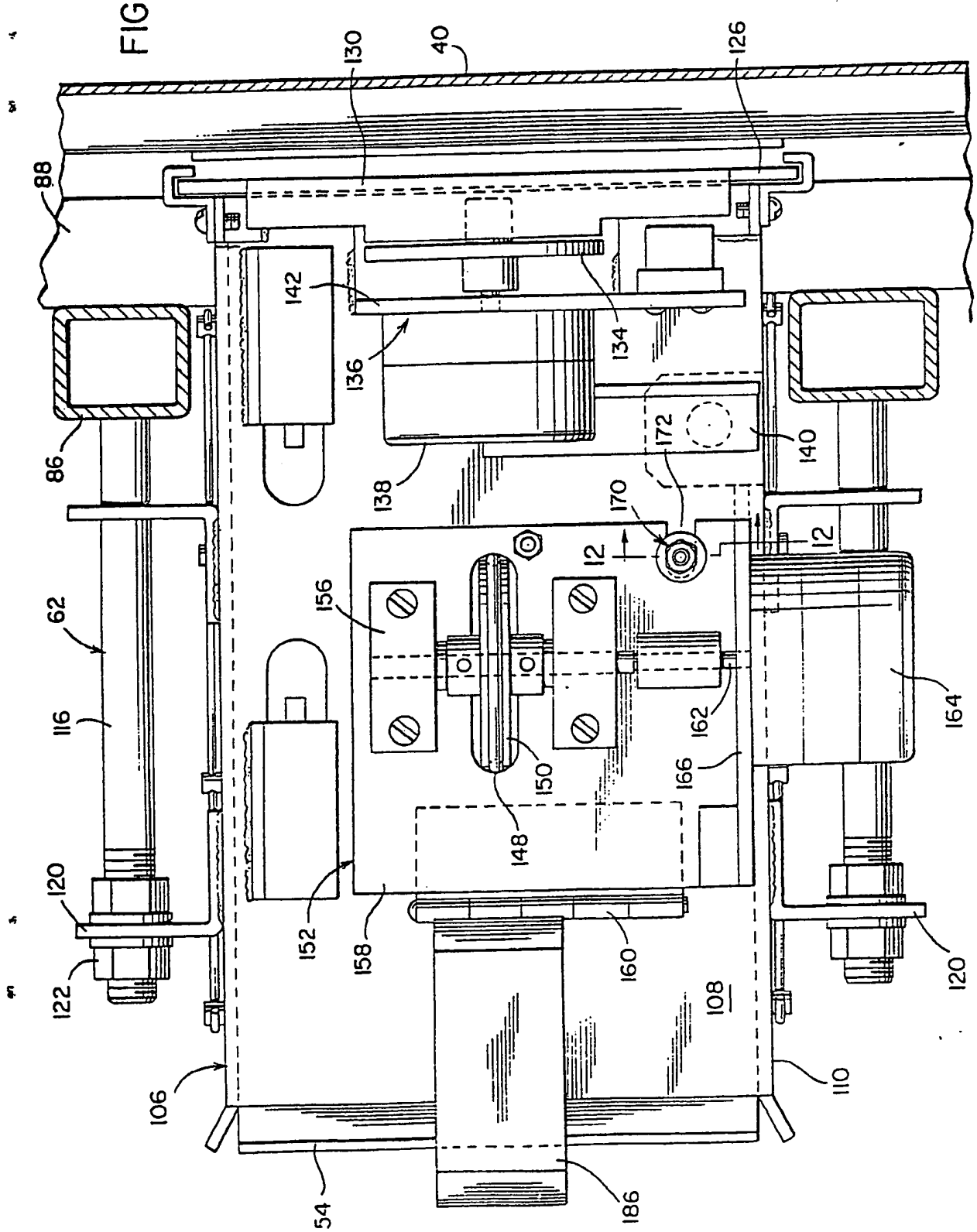
84
182
180
176
66
158
178
172
106
174
108

FIG. 11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40
126
88
142
134
136
172
140
138
170
12
12
156
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166
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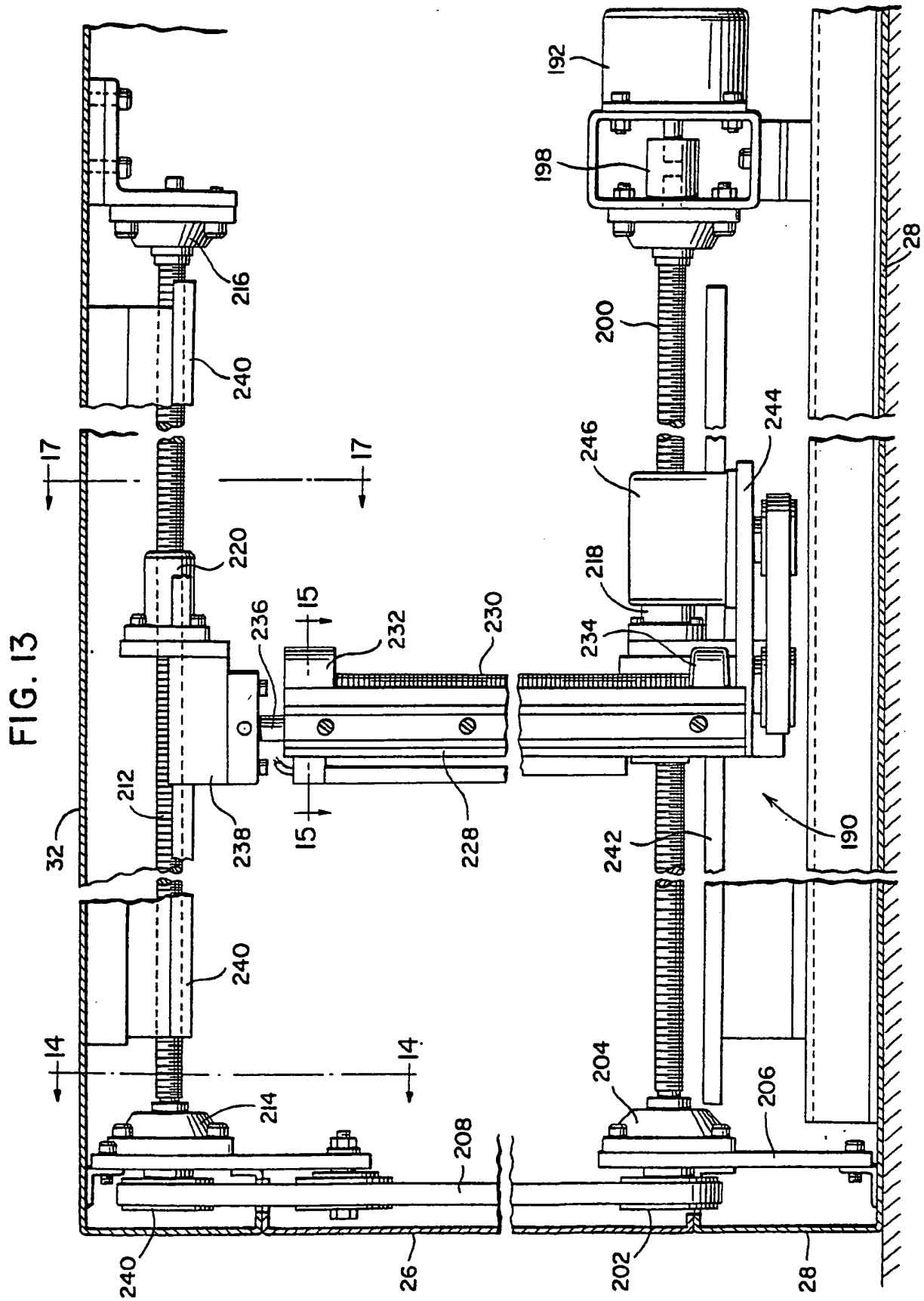
120
152
158
160
120
122
108
106
110
54
186

FIG. 13


192
198
28
200
216
240
244
246
17
17
220
218
15
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232
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14
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26
202
28

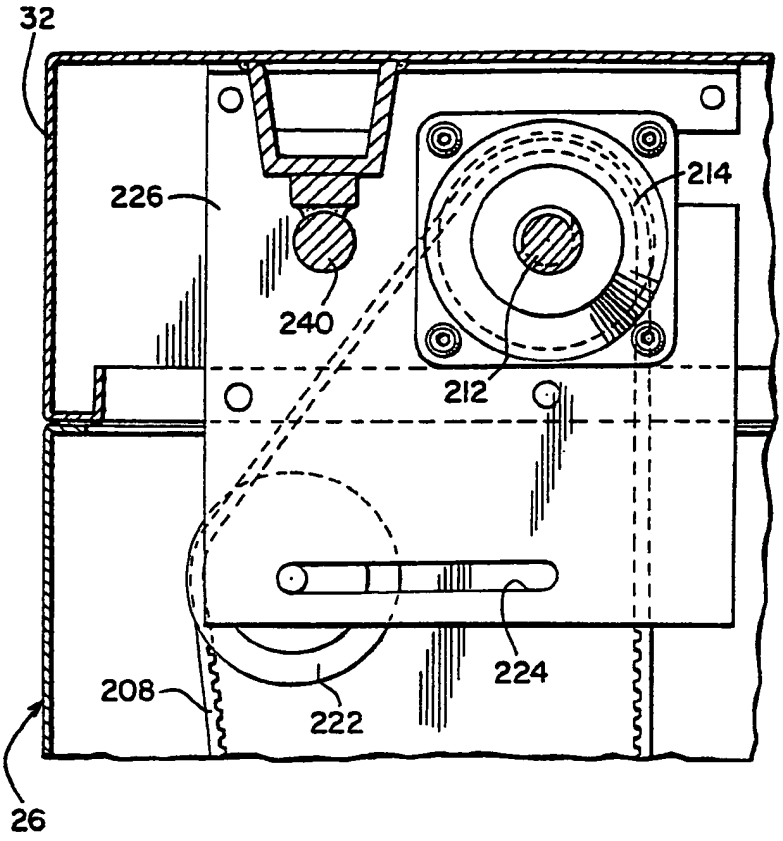



FIG. 14

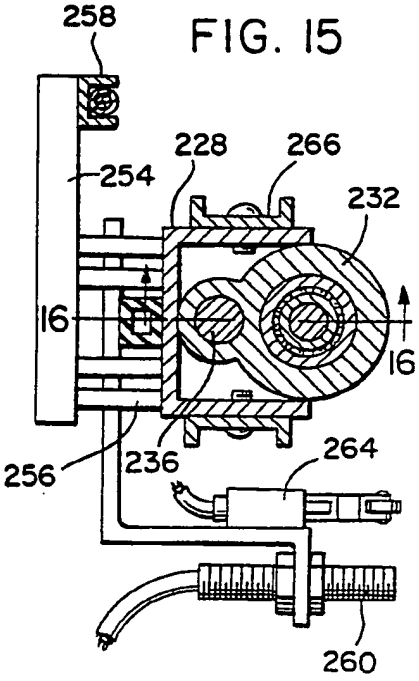



FIG. 15

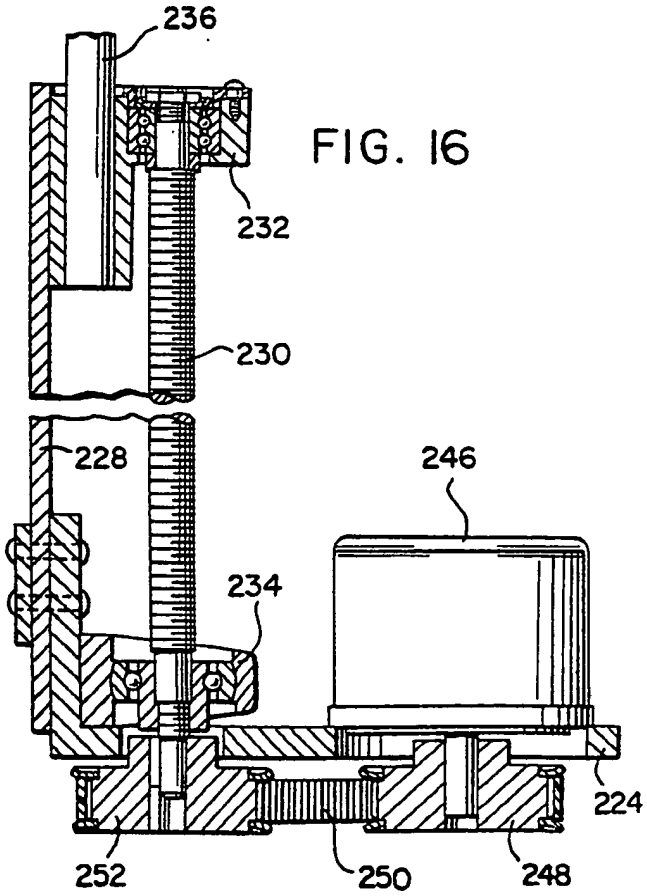



FIG. 16

FIG. 17

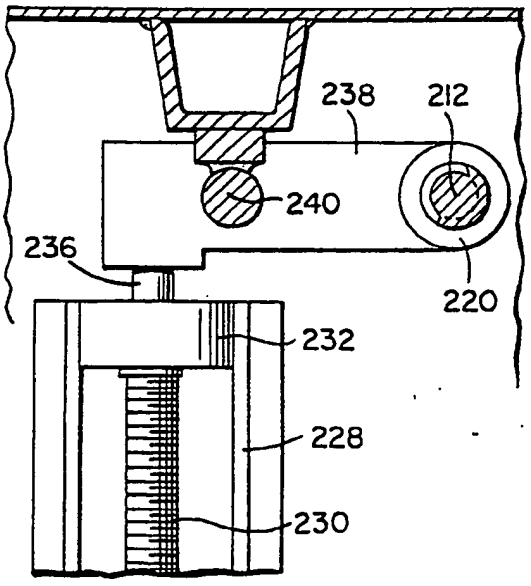
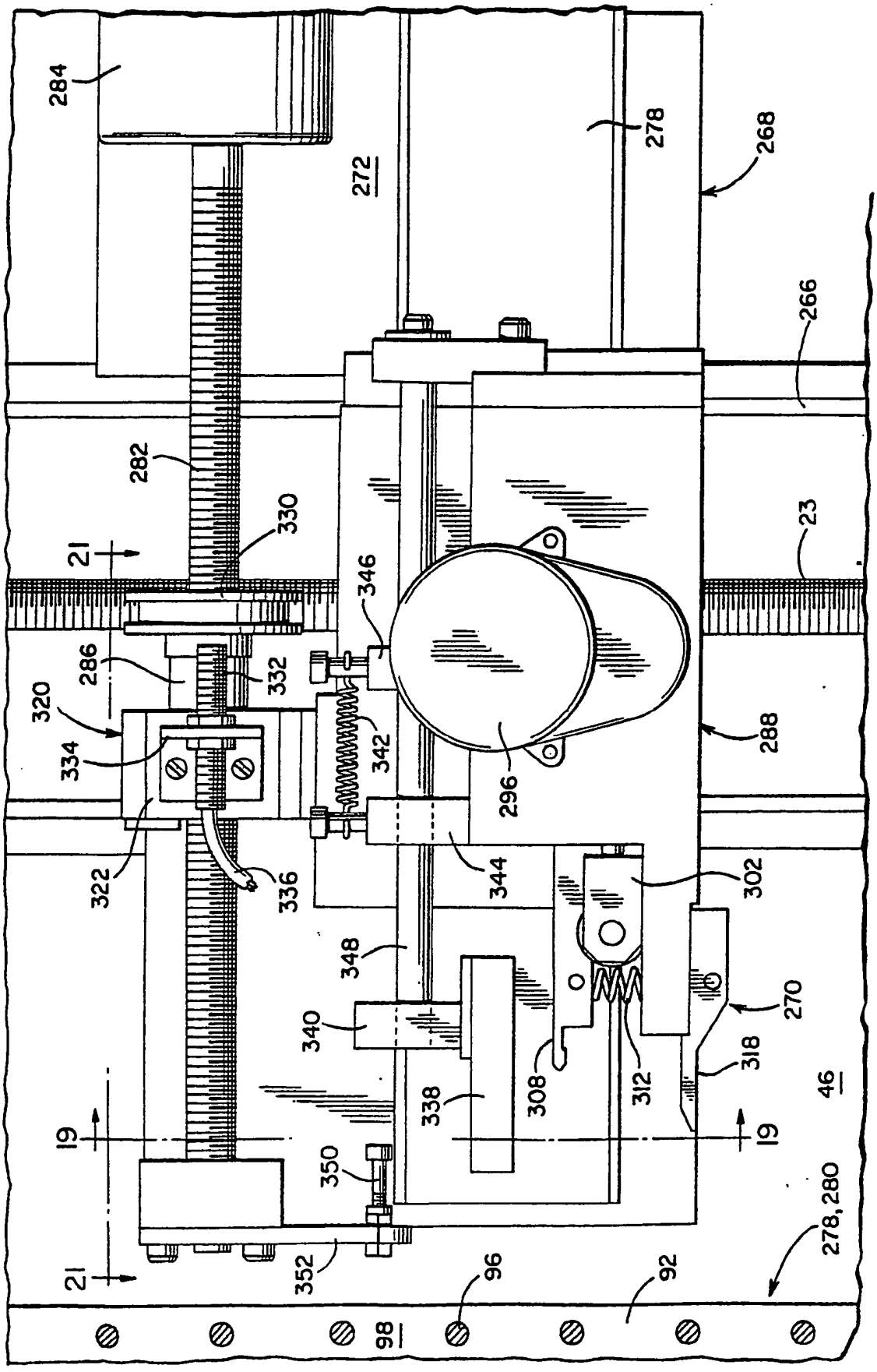


FIG. 18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272
278
268
266
282
330
23
21
346
286
332
320
334
342
288
296
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336
344
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308
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46
19
19
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278,280
352
21
96
92
98

FIG. 19

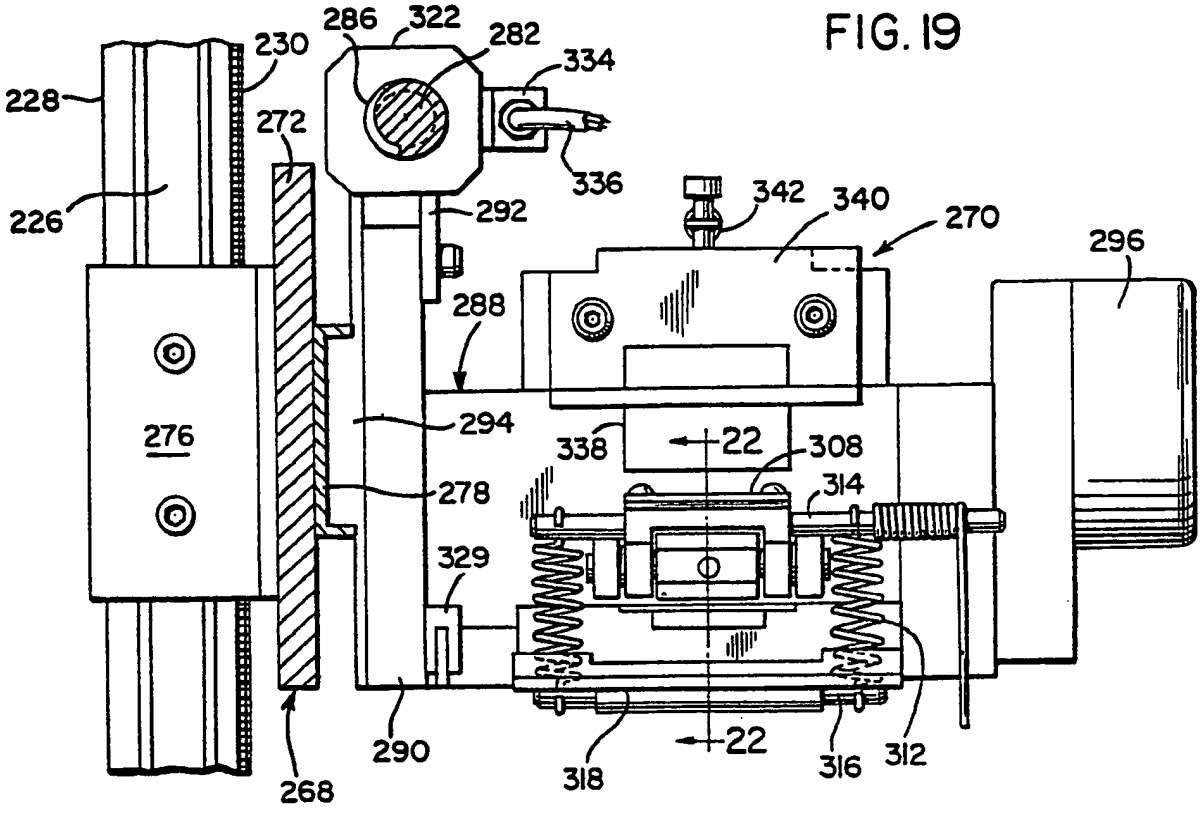



FIG. 20

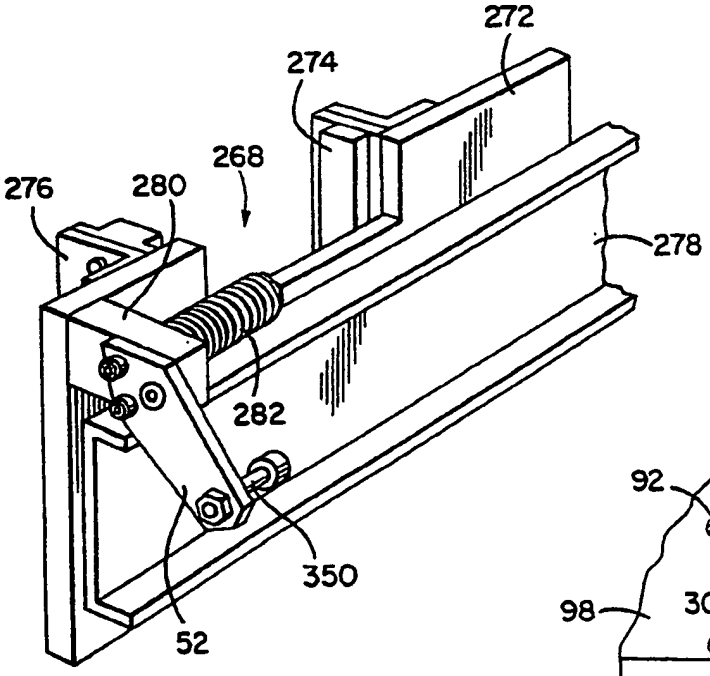



FIG. 23

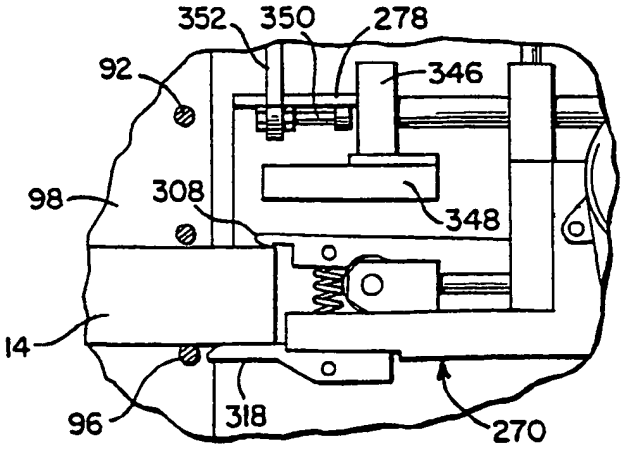
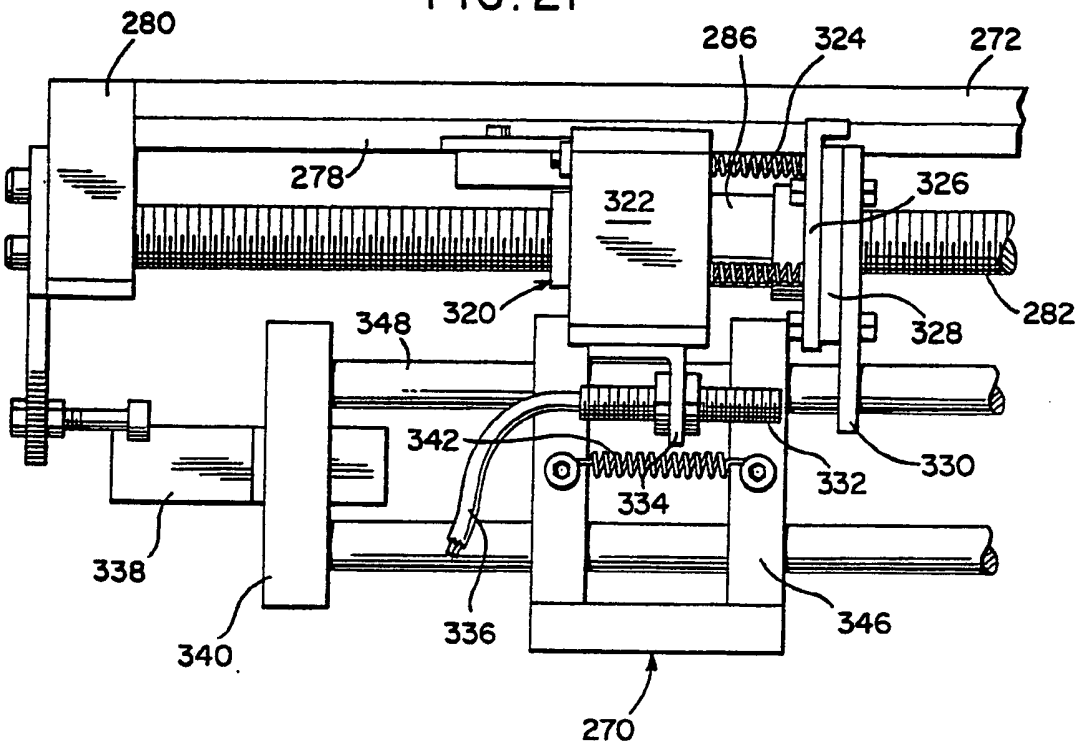


FIG. 21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286
324
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322
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320
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328
282
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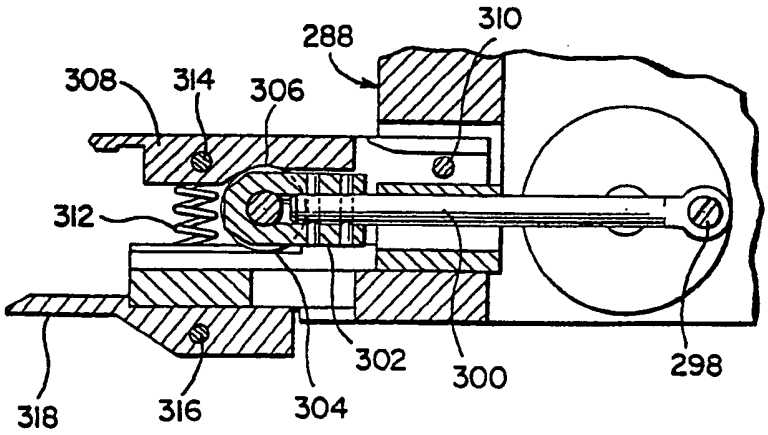
330
332
334
338
336
346
340
270

FIG. 22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288
308
314
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312
302
300
298
318
316
304

FIG. 24

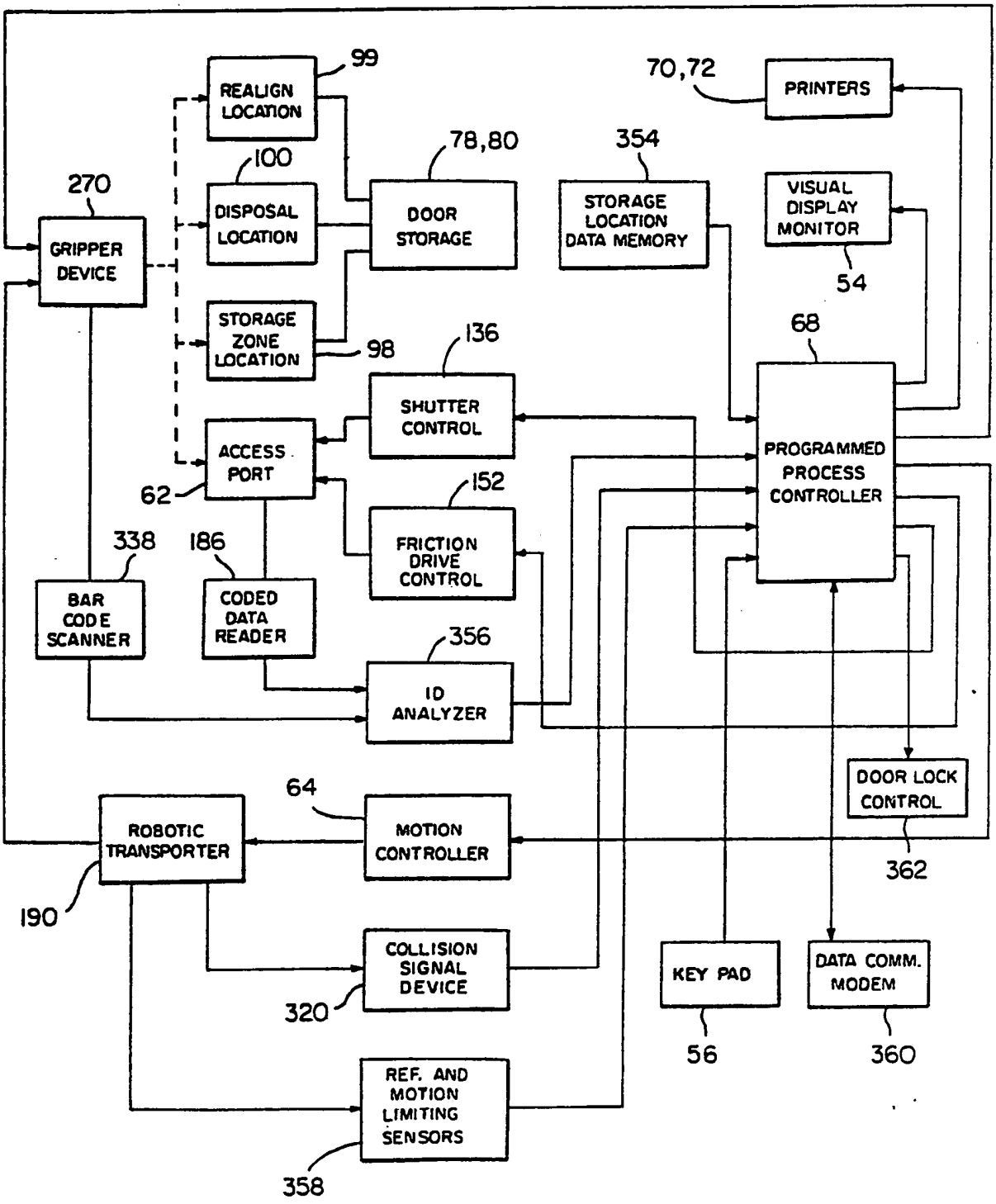

REALIGN LOCATION
99
70,72
PRINTERS
100
78,80
354
270
DISPOSAL LOCATION
DOOR STORAGE
STORAGE LOCATION DATA MEMORY
VISUAL DISPLAY MONITOR
GRIPPER DEVICE
54
STORAGE ZONE LOCATION
98
136
68
SHUTTER CONTROL
ACCESS PORT
62
152
PROGRAMMED PROCESS CONTROLLER
FRICTION DRIVE CONTROL
338
186
BAR CODE SCANNER
CODED DATA READER
356
ID ANALYZER
DOOR LOCK CONTROL
64
ROBOTIC TRANSPORTER
MOTION CONTROLLER
362
190
COLLISION SIGNAL DEVICE
KEY PAD
DATA COMM. MODEM
320
56
360
REF. AND MOTION LIMITING SENSORS
358

FIG.25

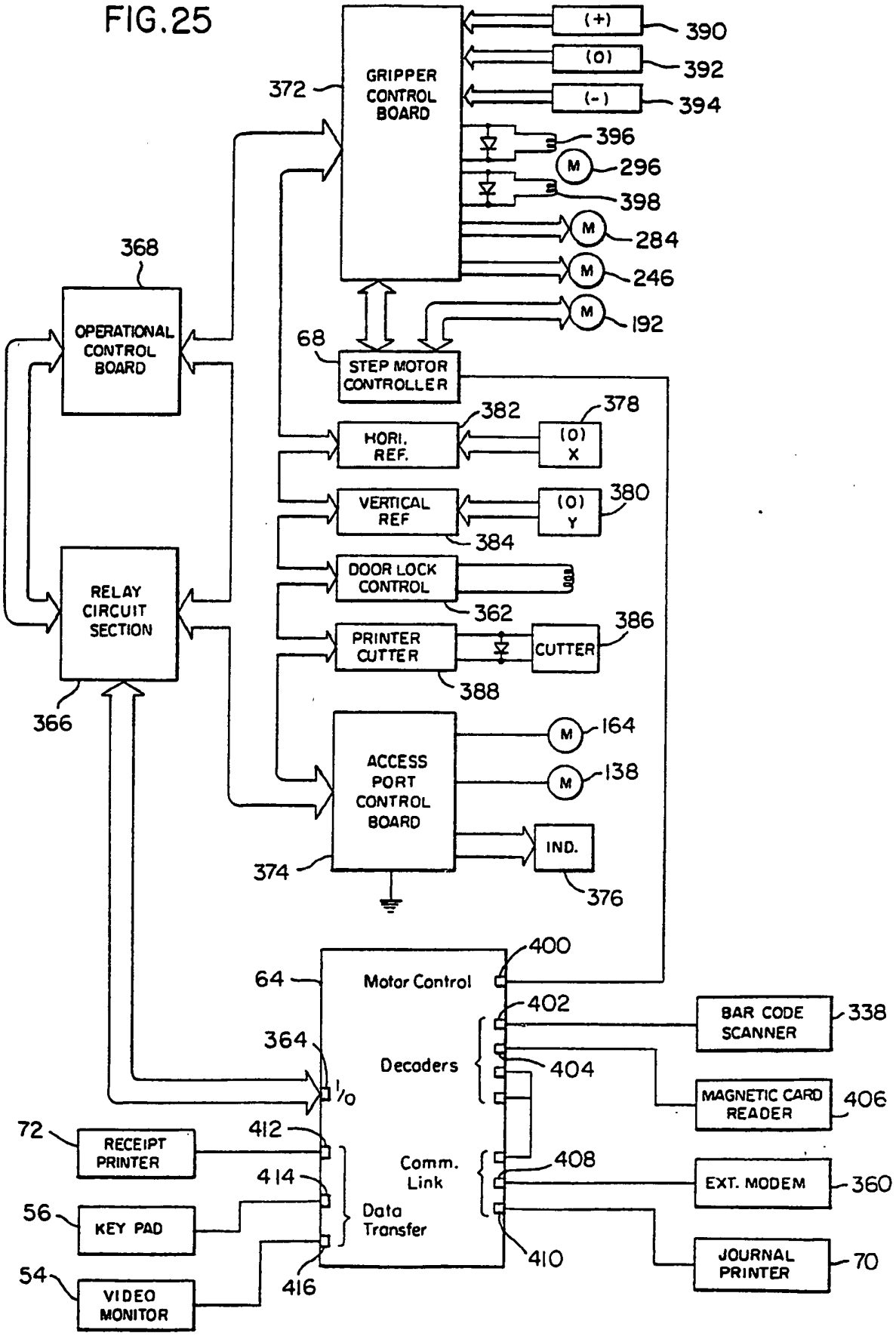

GRIPPER CONTROL BOARD
372
(+)
390
(0)
392
(-)
394
396
M
296
398
M
284
M
246
M
192
OPERATIONAL CONTROL BOARD
368
68
STEP MOTOR CONTROLLER
HORI. REF.
382
(0) X
378
VERTICAL REF
(0) Y
380
384
DOOR LOCK CONTROL
362
RELAY CIRCUIT SECTION
366
PRINTER CUTTER
CUTTER
386
388
ACCESS PORT CONTROL BOARD
M
164
M
138
IND.
374
376
Motor Control
400
64
402
BAR CODE SCANNER
338
364
Decoders
404
I/O
MAGNETIC CARD READER
406
72
RECEIPT PRINTER
412
Comm. Link
408
414
EXT. MODEM
360
56
KEY PAD
Data Transfer
410
JOURNAL PRINTER
70
54
VIDEO MONITOR
416

FIG. 26

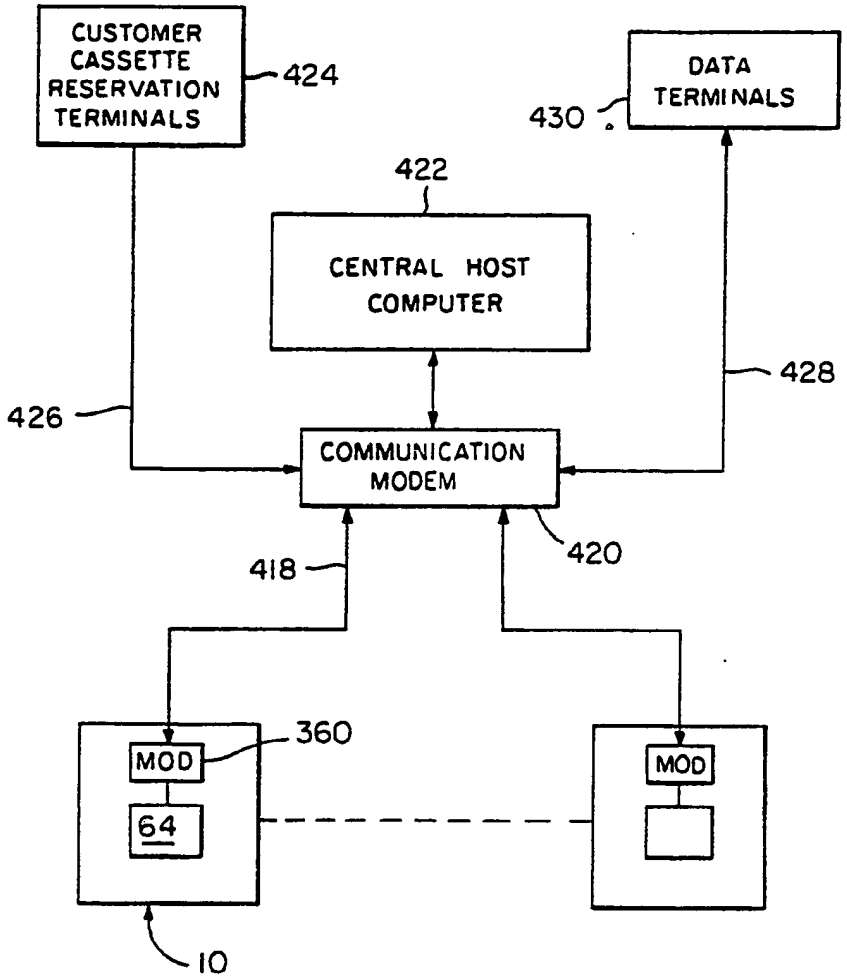

CUSTOMER CASSETTE RESERVATION TERMINALS
424
DATA TERMINALS
430
422
CENTRAL HOST COMPUTER
428
426
COMMUNICATION MODEM
420
418
360
MOD
64
MOD
10

FIG. 28

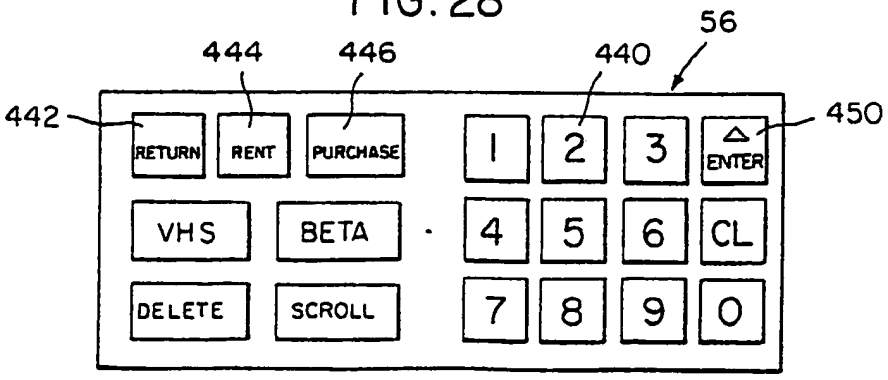

56
444
446
440
442
450
RETURN
RENT
PURCHASE
1
2
3
ENTER
VHS
BETA
4
5
6
CL
DELETE
SCROLL
7
8
9
0

FIG. 27

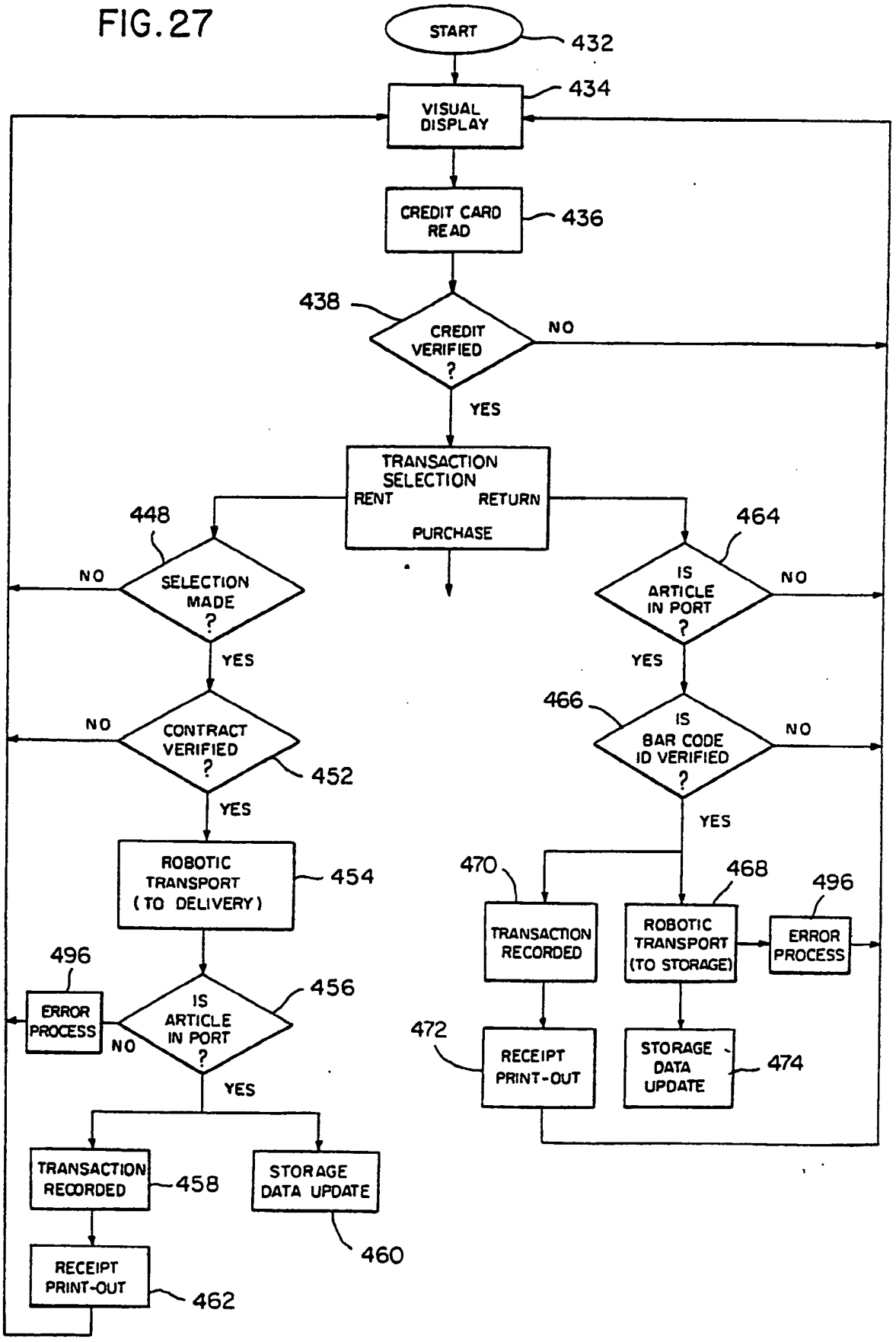

START
432
VISUAL DISPLAY
434
CREDIT CARD READ
436
438
CREDIT VERIFIED ?
NO
YES
TRANSACTION SELECTION
RENT
RETURN
PURCHASE
448
SELECTION MADE ?
NO
YES
CONTRACT VERIFIED ?
NO
452
YES
ROBOTIC TRANSPORT (TO DELIVERY)
454
496
ERROR PROCESS
IS ARTICLE IN PORT ?
456
NO
YES
TRANSACTION RECORDED
458
STORAGE DATA UPDATE
460
RECEIPT PRINT-OUT
462
464
IS ARTICLE IN PORT ?
NO
YES
466
IS BAR CODE ID VERIFIED ?
NO
YES
470
TRANSACTION RECORDED
468
ROBOTIC TRANSPORT (TO STORAGE)
496
ERROR PROCESS
472
RECEIPT PRINT-OUT
STORAGE DATA UPDATE
474

FIG. 29

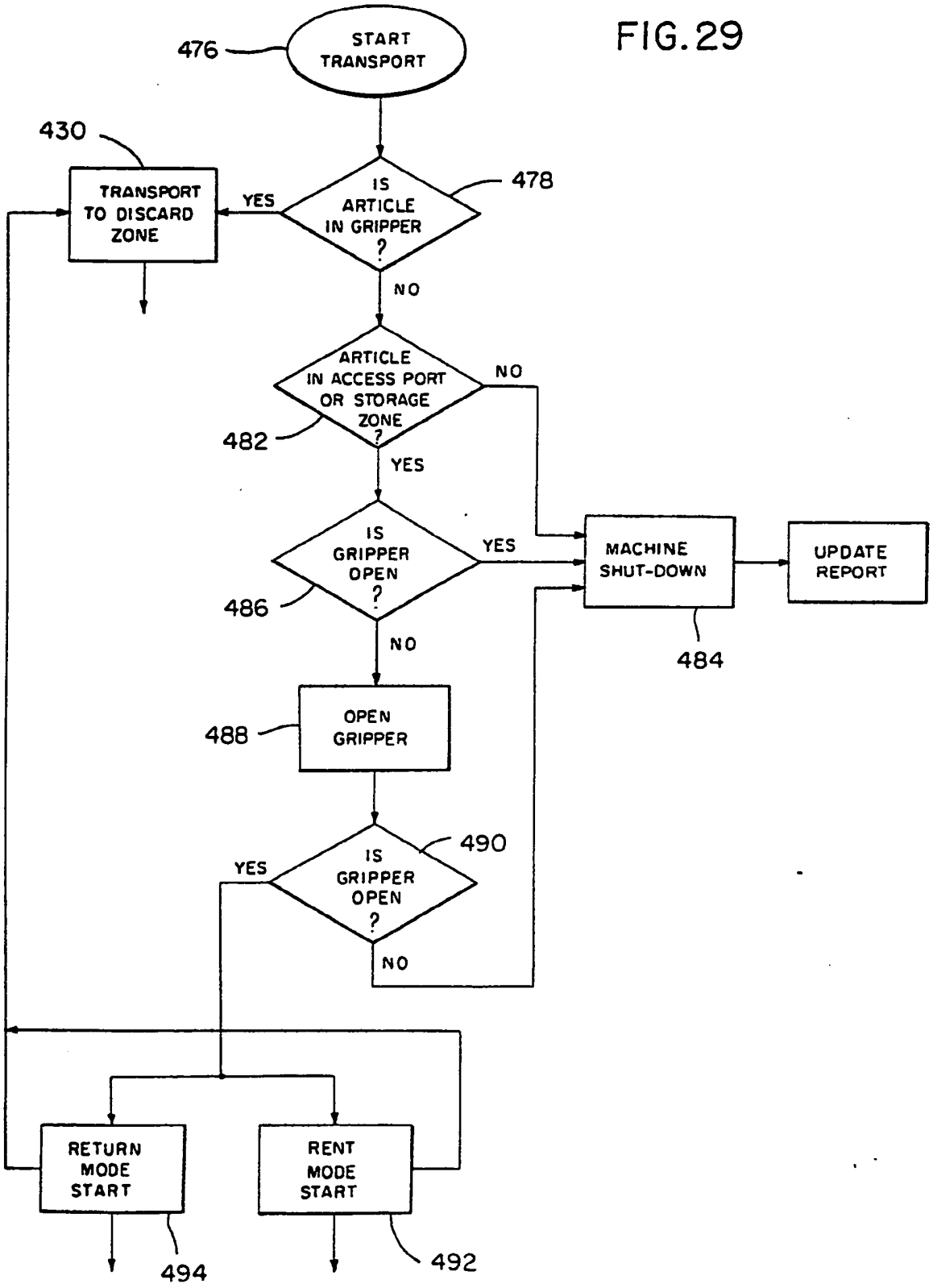

476
START TRANSPORT
430
TRANSPORT TO DISCARD ZONE
YES
IS ARTICLE IN GRIPPER ?
478
NO
ARTICLE IN ACCESS PORT OR STORAGE ZONE ?
NO
482
YES
IS GRIPPER OPEN ?
YES
MACHINE SHUT-DOWN
UPDATE REPORT
486
NO
484
488
OPEN GRIPPER
490
IS GRIPPER OPEN ?
YES
NO
RETURN MODE START
RENT MODE START
494
492

FIG. 30

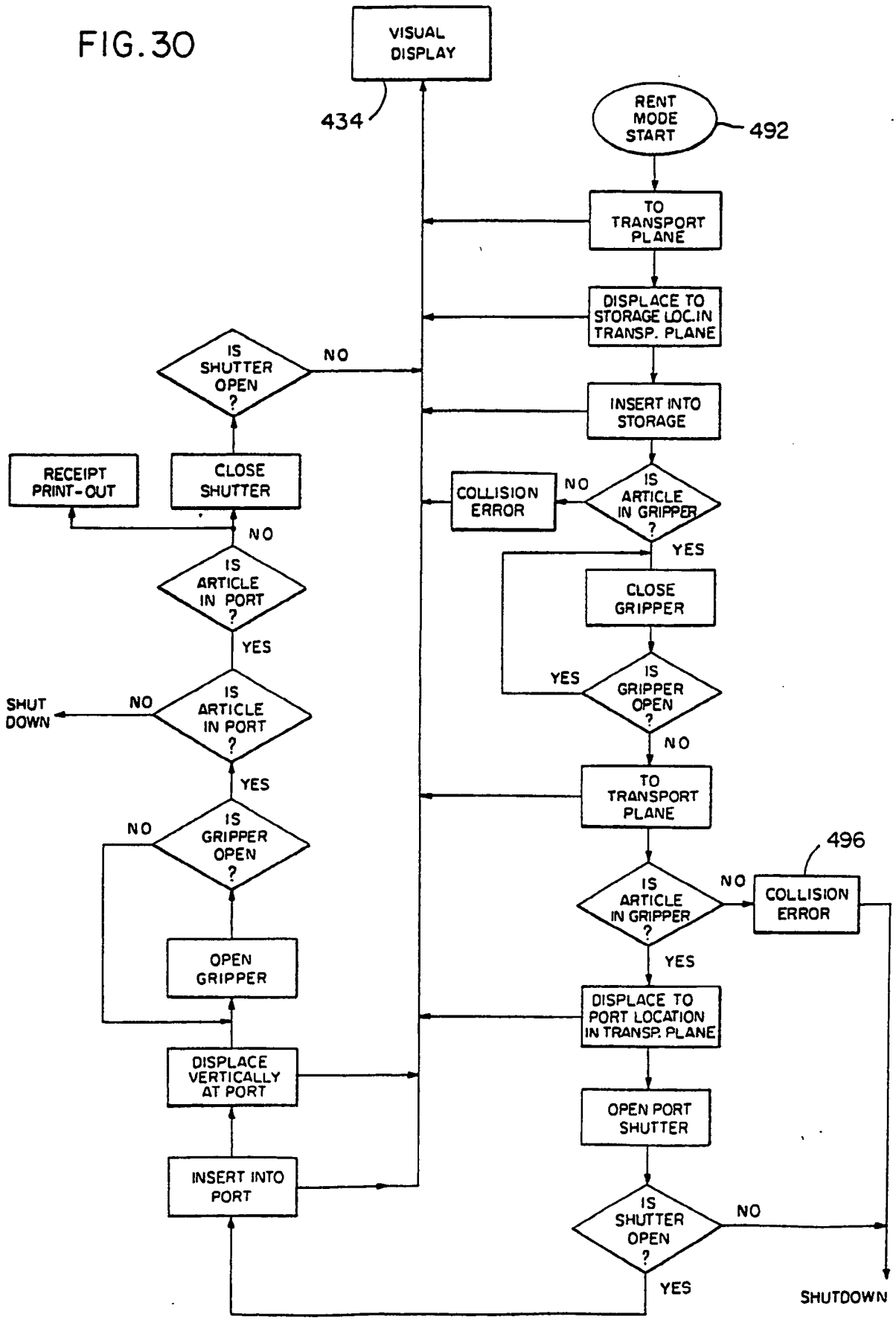
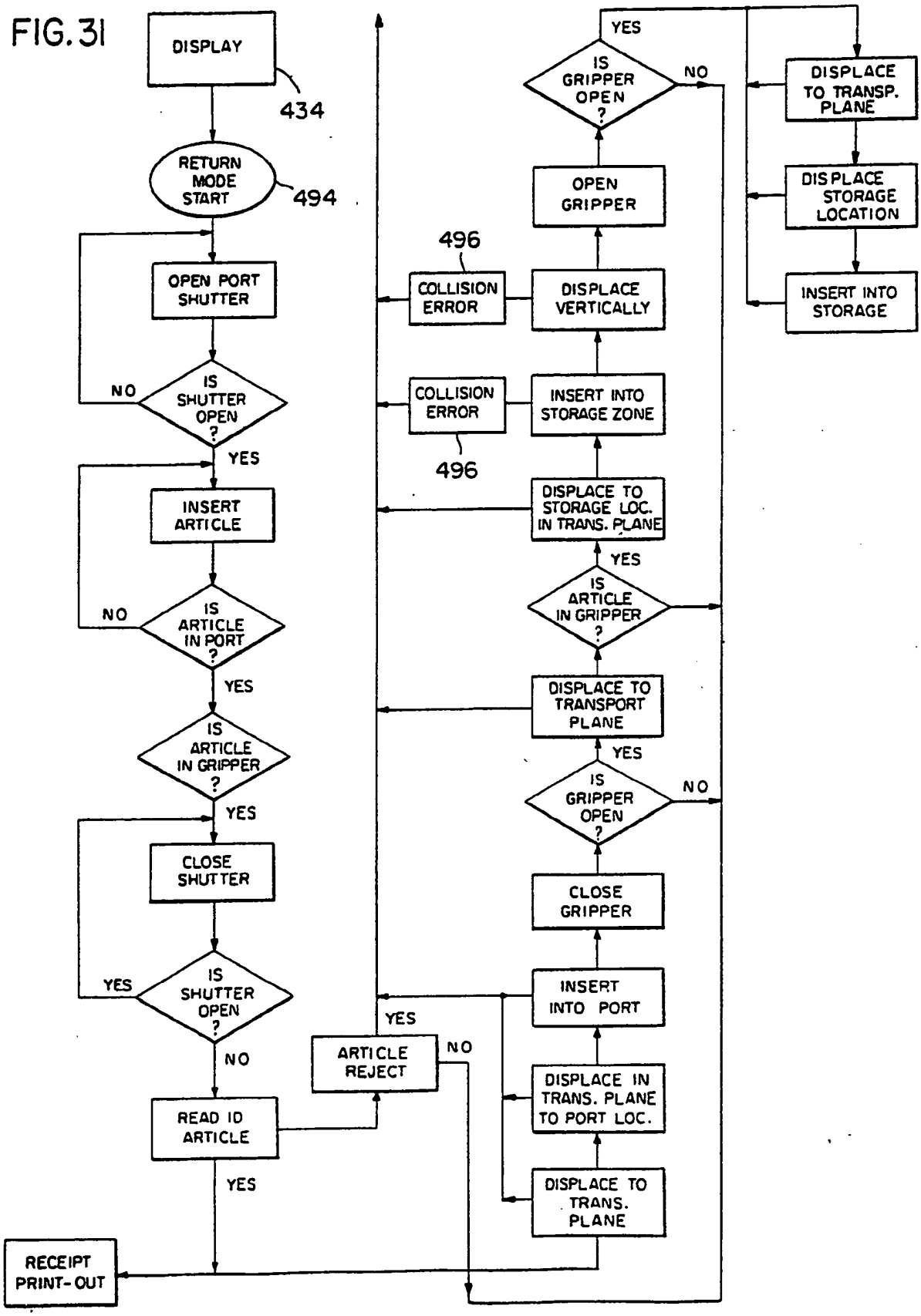

VISUAL DISPLAY
434
RENT MODE START
492
TO TRANSPORT PLANE
DISPLACE TO STORAGE LOC.IN TRANSP. PLANE
INSERT INTO STORAGE
IS ARTICLE IN GRIPPER ?
NO
COLLISION ERROR
YES
CLOSE GRIPPER
IS GRIPPER OPEN ?
YES
NO
TO TRANSPORT PLANE
496
IS ARTICLE IN GRIPPER ?
NO
COLLISION ERROR
YES
DISPLACE TO PORT LOCATION IN TRANSP. PLANE
OPEN PORT SHUTTER
IS SHUTTER OPEN ?
NO
YES
SHUTDOWN
IS SHUTTER OPEN ?
NO
CLOSE SHUTTER
RECEIPT PRINT-OUT
NO
IS ARTICLE IN PORT ?
YES
IS ARTICLE IN PORT ?
NO
SHUT DOWN
YES
IS GRIPPER OPEN ?
NO
OPEN GRIPPER
DISPLACE VERTICALLY AT PORT
INSERT INTO PORT

FIG. 31


DISPLAY
434
RETURN MODE START
494
OPEN PORT SHUTTER
IS SHUTTER OPEN ?
NO
YES
INSERT ARTICLE
IS ARTICLE IN PORT ?
NO
YES
IS ARTICLE IN GRIPPER ?
YES
CLOSE SHUTTER
IS SHUTTER OPEN ?
YES
NO
READ ID ARTICLE
YES
RECEIPT PRINT-OUT
ARTICLE REJECT
YES
NO
IS GRIPPER OPEN ?
YES
NO
OPEN GRIPPER
496
COLLISION ERROR
DISPLACE VERTICALLY
COLLISION ERROR
496
INSERT INTO STORAGE ZONE
DISPLACE TO STORAGE LOC. IN TRANS. PLANE
YES
IS ARTICLE IN GRIPPER ?
DISPLACE TO TRANSPORT PLANE
YES
IS GRIPPER OPEN ?
YES
NO
CLOSE GRIPPER
INSERT INTO PORT
DISPLACE IN TRANS. PLANE TO PORT LOC.
DISPLACE TO TRANS. PLANE
DISPLACE TO TRANSP. PLANE
DISPLACE STORAGE LOCATION
INSERT INTO STORAGE

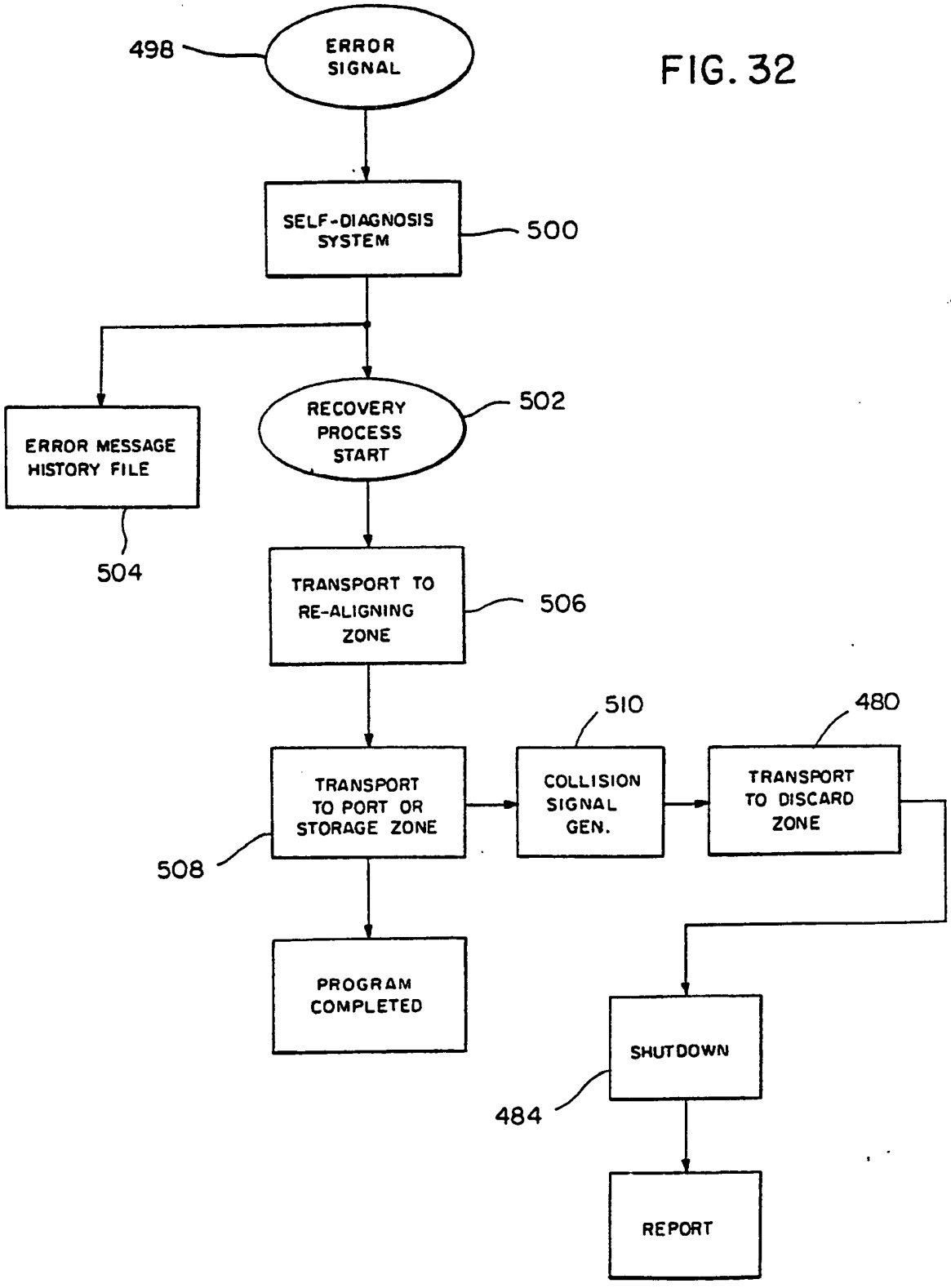

498
ERROR SIGNAL
SELF-DIAGNOSIS SYSTEM
500
ERROR MESSAGE HISTORY FILE
504
RECOVERY PROCESS START
502
TRANSPORT TO RE-ALIGNING ZONE
506
510
480
TRANSPORT TO PORT OR STORAGE ZONE
508
COLLISION SIGNAL GEN.
TRANSPORT TO DISCARD ZONE
PROGRAM COMPLETED
SHUTDOWN
484
REPORT

FIG. 32

FIG. 33

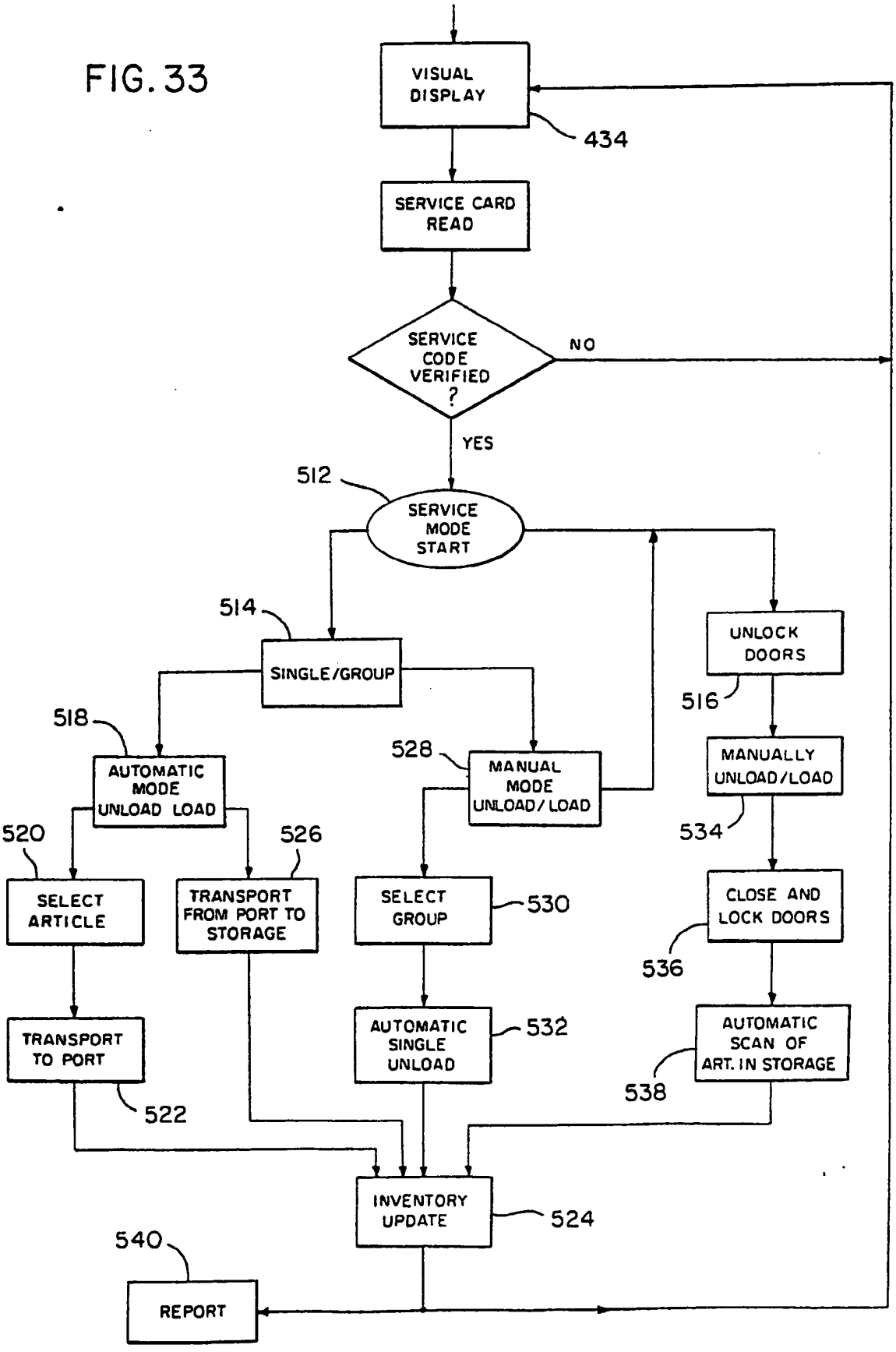

VISUAL DISPLAY
434
SERVICE CARD READ
SERVICE CODE VERIFIED ?
NO
YES
512
SERVICE MODE START
514
SINGLE/GROUP
UNLOCK DOORS
516
518
AUTOMATIC MODE UNLOAD LOAD
528
MANUAL MODE UNLOAD/LOAD
MANUALLY UNLOAD/LOAD
534
520
526
SELECT ARTICLE
TRANSPORT FROM PORT TO STORAGE
SELECT GROUP
530
CLOSE AND LOCK DOORS
536
TRANSPORT TO PORT
AUTOMATIC SINGLE UNLOAD
532
AUTOMATIC SCAN OF ART. IN STORAGE
538
522
INVENTORY UPDATE
524
540
REPORT

FIG. 34

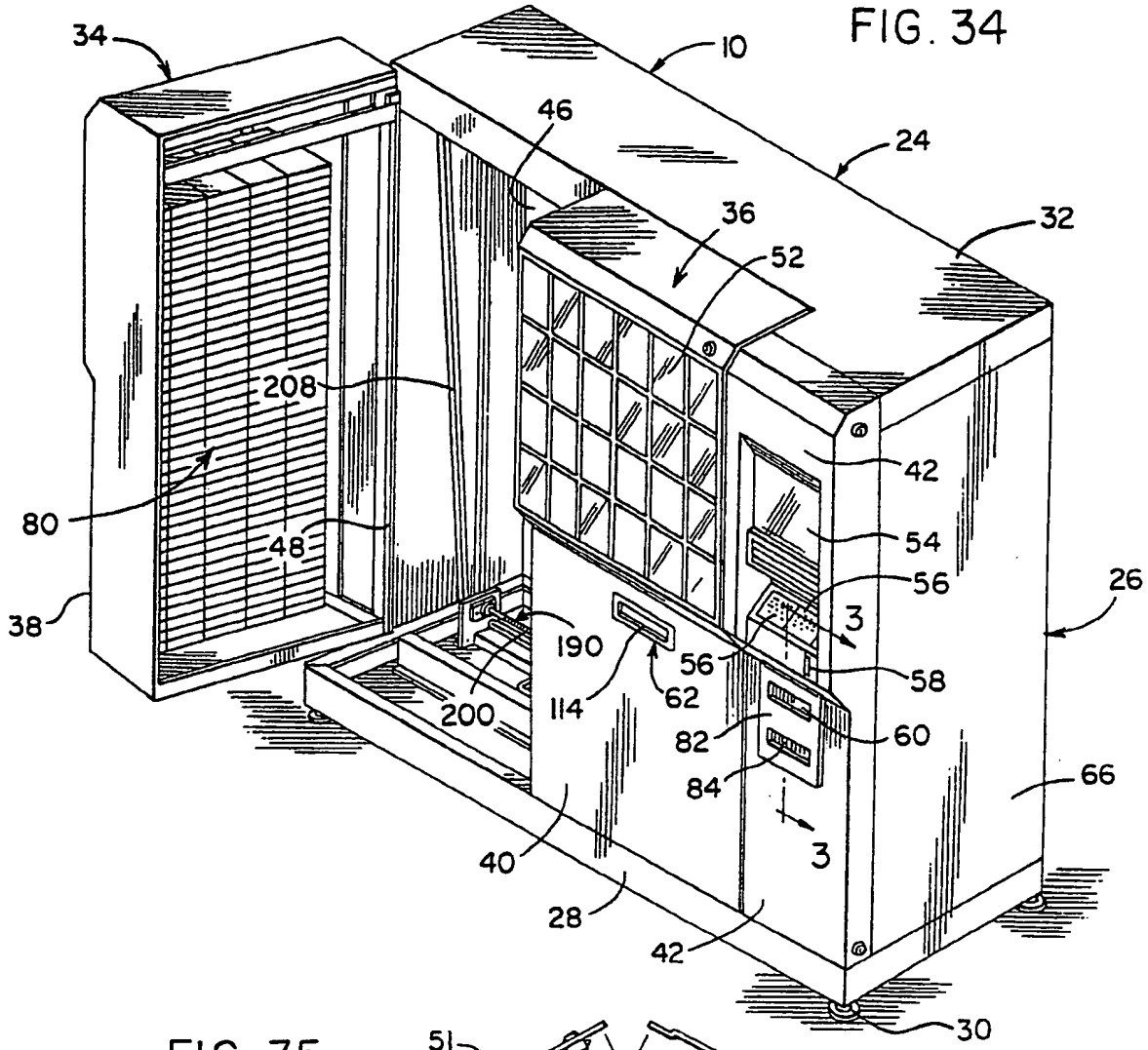

34
10
46
24
36
52
32
208
42
80
48
54
56
26
38
3
190
56
58
62
114
200
82
60
84
66
3
40
28
42
30

FIG. 35

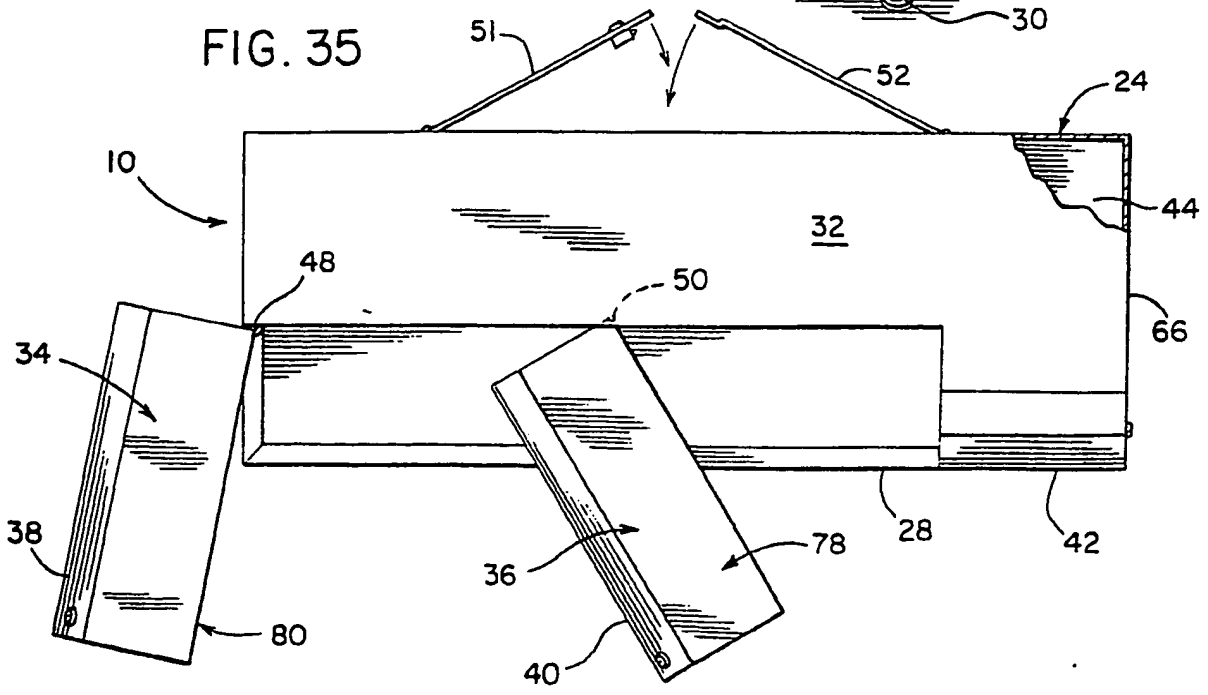

51
52
24
10
44
32
48
50
66
34
38
28
42
78
36
80
40

FIG. 36

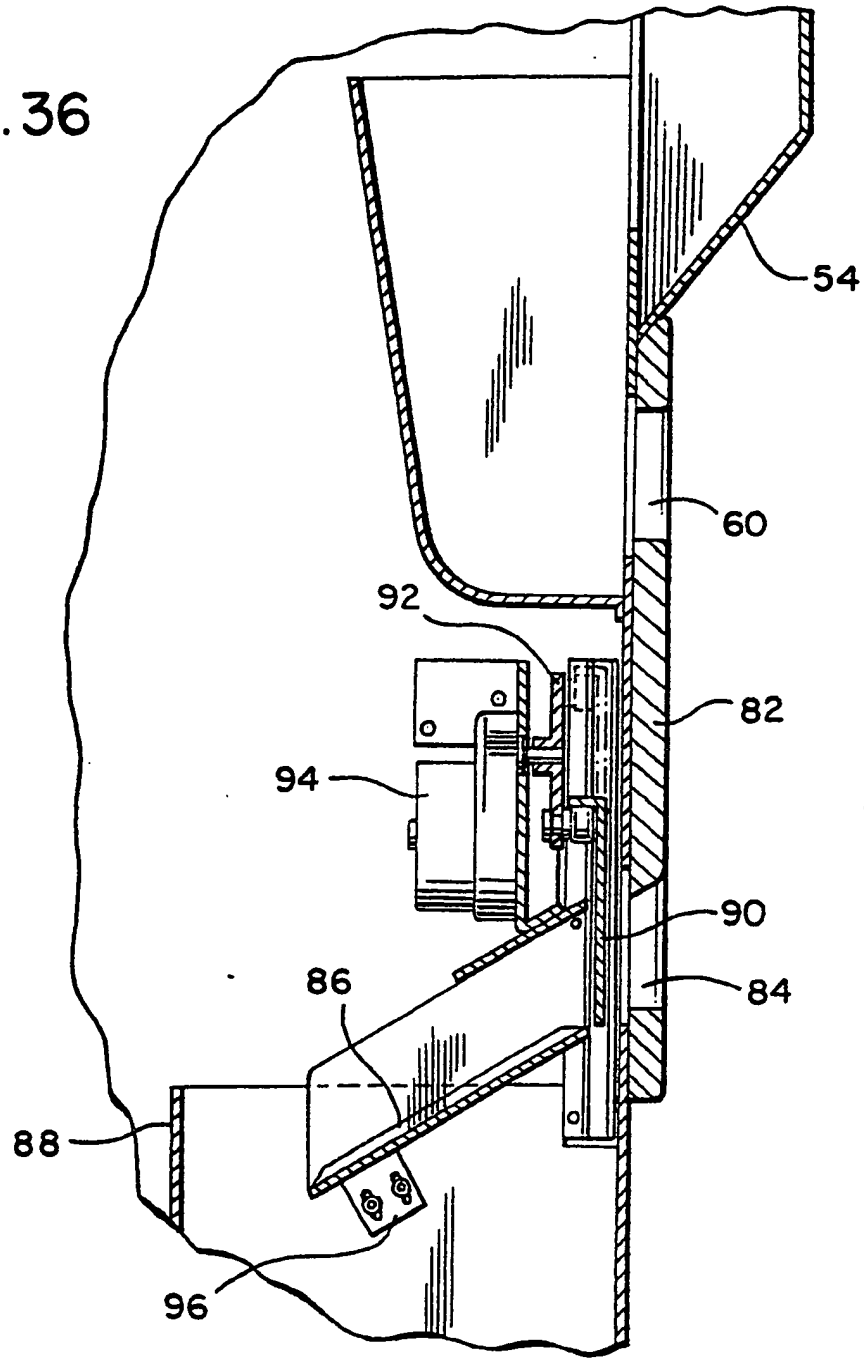


FIG. 37

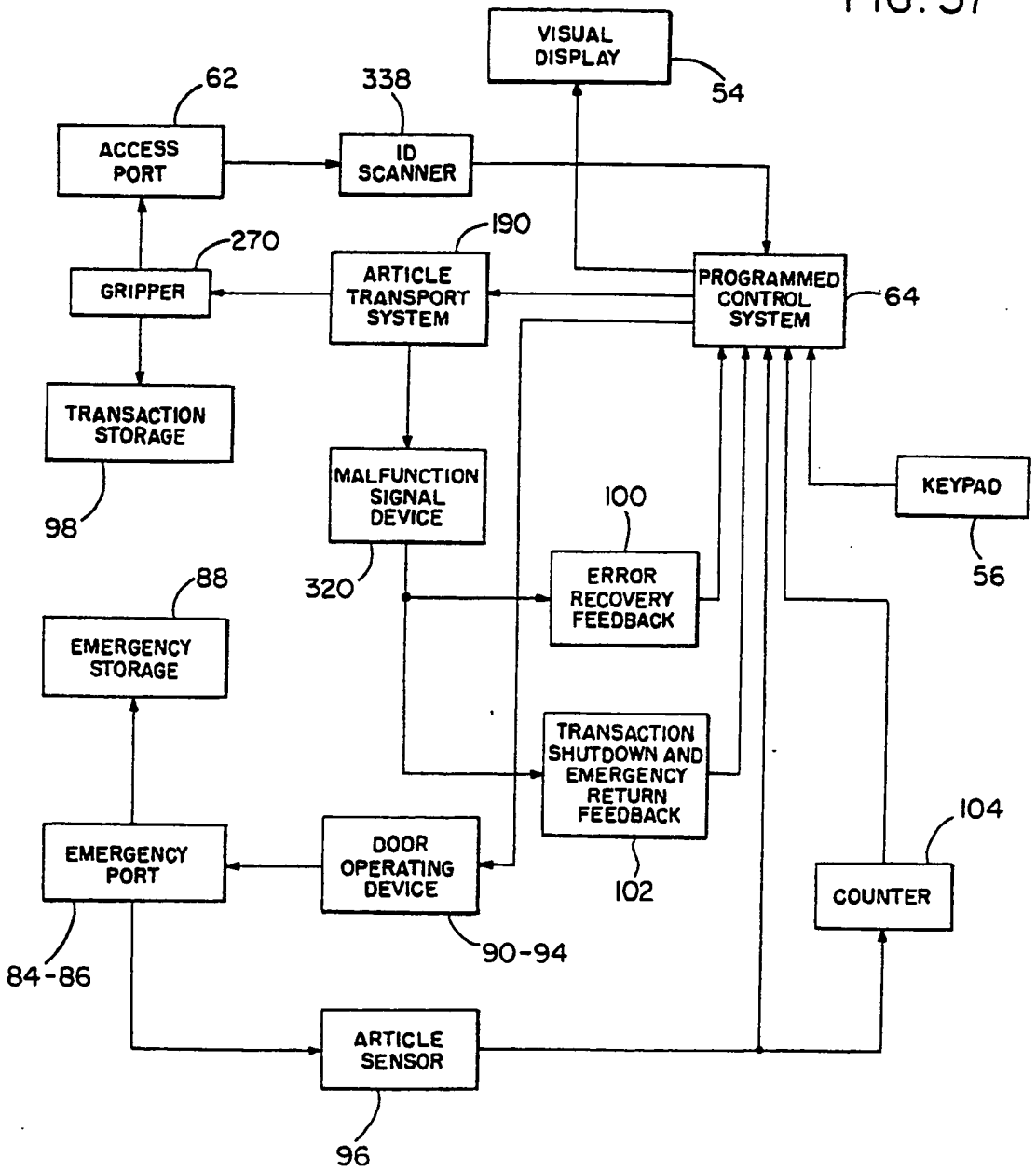

VISUAL DISPLAY
54
62
338
ACCESS PORT
ID SCANNER
190
270
GRIPPER
ARTICLE TRANSPORT SYSTEM
PROGRAMMED CONTROL SYSTEM
64
TRANSACTION STORAGE
98
MALFUNCTION SIGNAL DEVICE
320
100
KEYPAD
56
ERROR RECOVERY FEEDBACK
88
EMERGENCY STORAGE
TRANSACTION SHUTDOWN AND EMERGENCY RETURN FEEDBACK
102
104
EMERGENCY PORT
DOOR OPERATING DEVICE
COUNTER
84-86
90-94
ARTICLE SENSOR
96

FIG. 38

MODIFIED NORMAL RETURN MODE

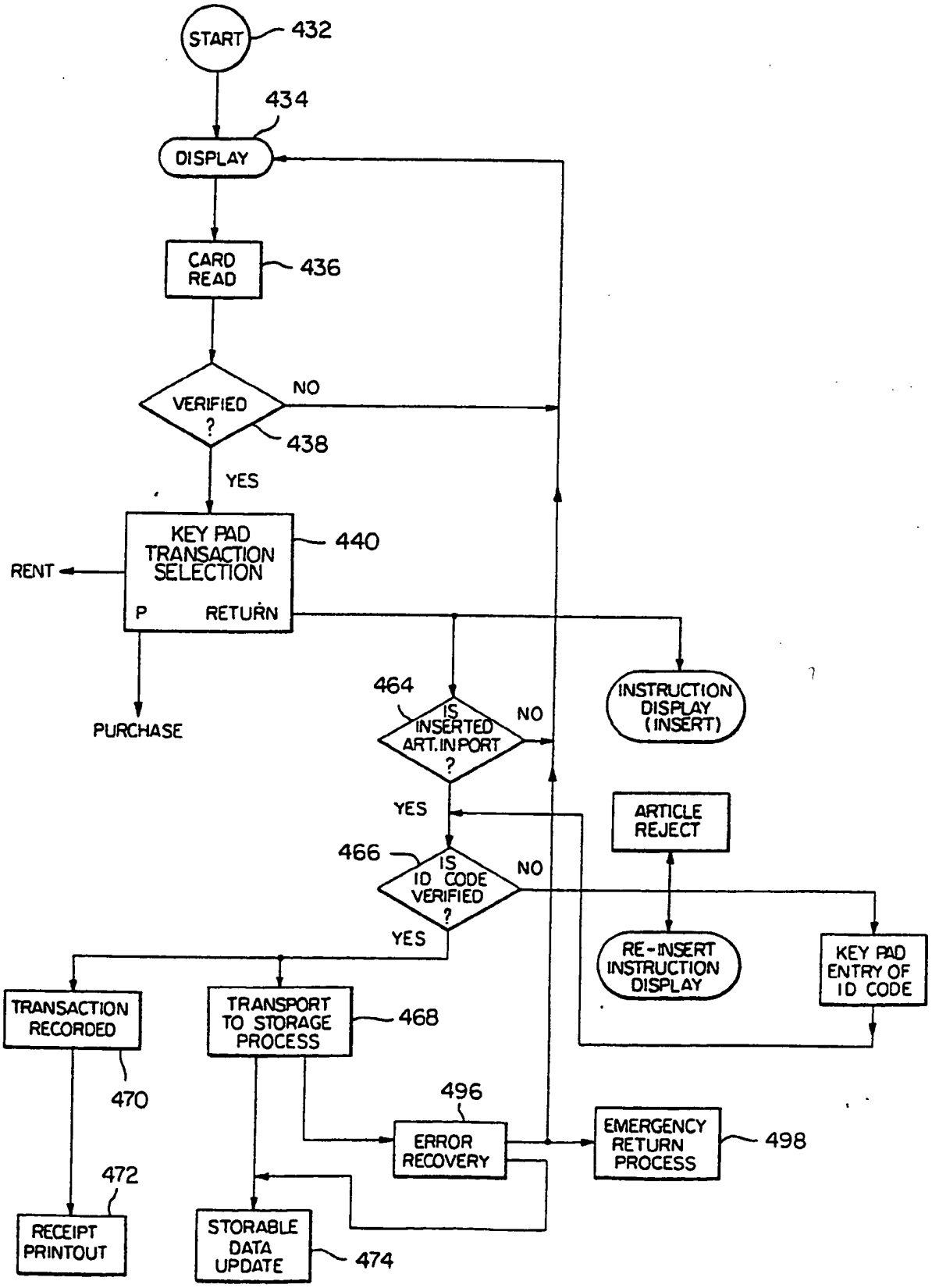


FIG. 39

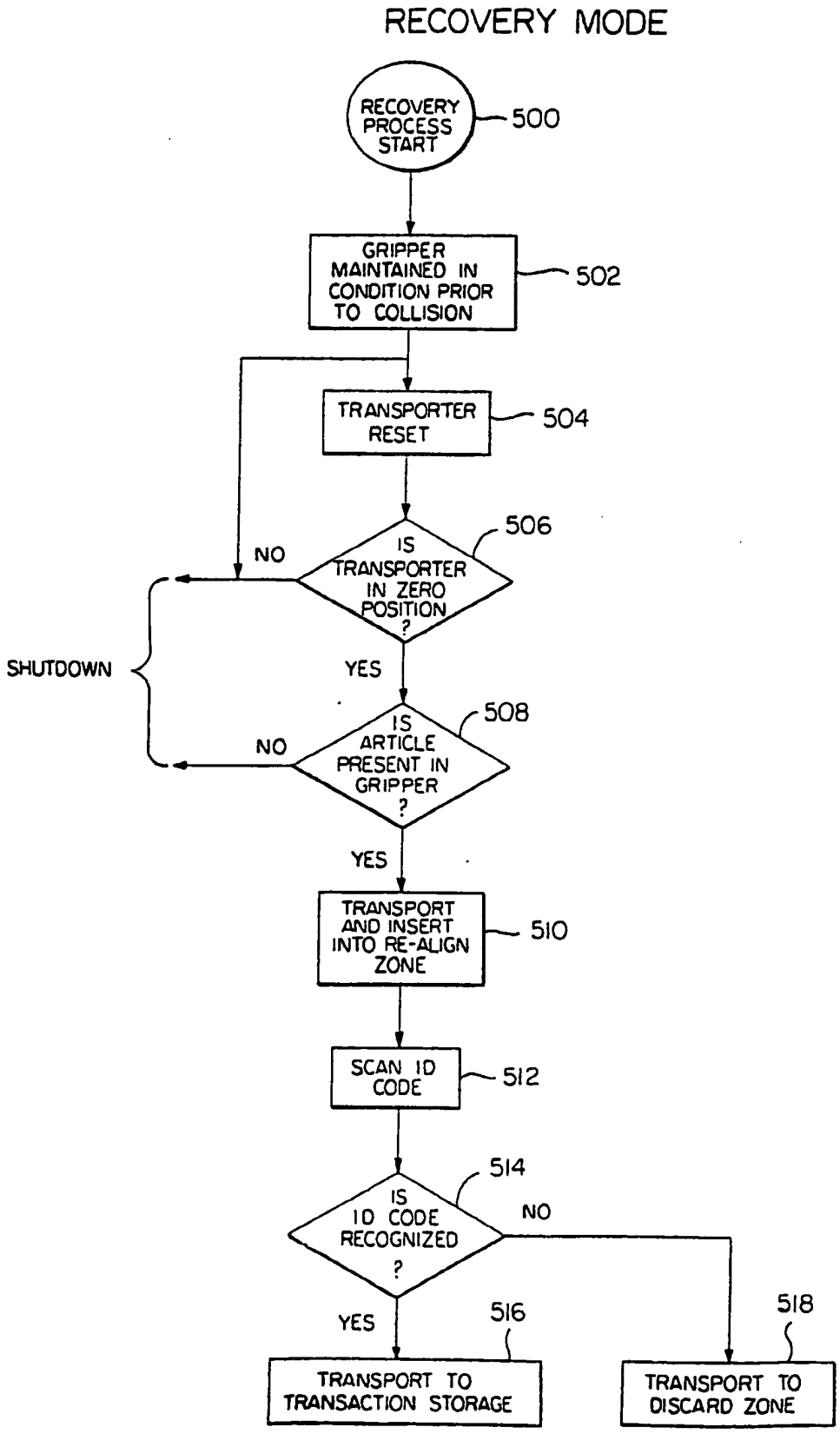
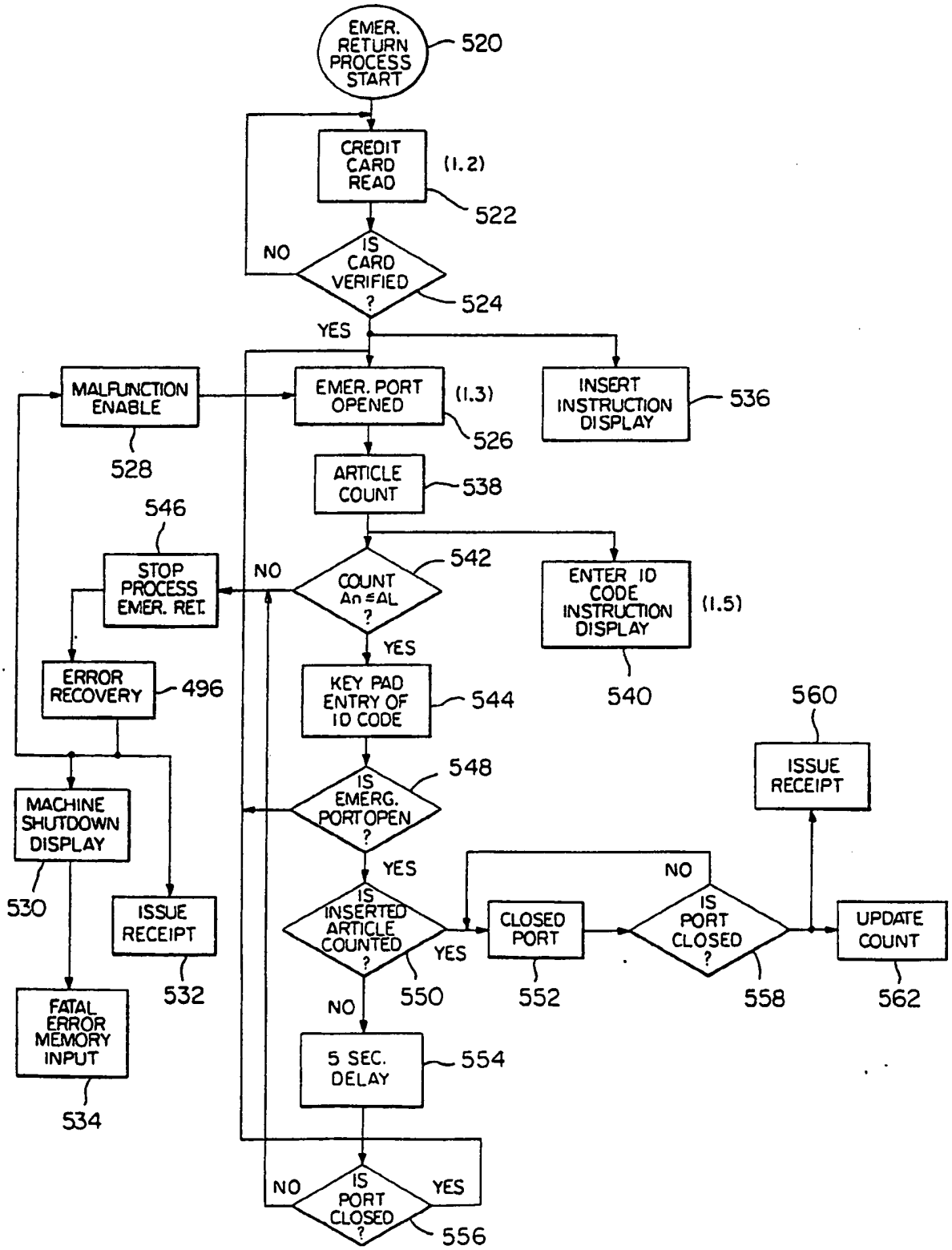

RECOVERY MODE
RECOVERY PROCESS START
500
GRIPPER MAINTAINED IN CONDITION PRIOR TO COLLISION
502
TRANSPORTER RESET
504
IS TRANSPORTER IN ZERO POSITION ?
506
NO
YES
SHUTDOWN
IS ARTICLE PRESENT IN GRIPPER ?
508
NO
YES
TRANSPORT AND INSERT INTO RE-ALIGN ZONE
510
SCAN ID CODE
512
IS ID CODE RECOGNIZED ?
514
NO
YES
516
518
TRANSPORT TO TRANSACTION STORAGE
TRANSPORT TO DISCARD ZONE

FIG. 40

EMERGENCY RETURN MODE



# INTERNATIONAL SEARCH REPORT

International Application No. PCT/US89/01243

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (4): G07F 7/06,7/10,11/16,17/00 235/381
U.S.CL.: 194/205,350;221/21,88,134,156;414/273,275,280,661;

## II. FIELDS SEARCHED

Minimum Documentation Searched [7]

| Classification System | Classification Symbols |
|---|---|
| U.S. | 194/205,350; 235/380,381<br>221/4,21,79,88,134,156,220,243,DIG.1; 186/55,56; 49<br>414/273-275,277,280-283,659-663; 901/13,32,39,44-47, |

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

## III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

| Category * | Citation of Document, [11] with indication, where appropriate, of the relevant passages [12] | Relevant to Claim No. [13] |
|---|---|---|
| X | US,A, 3,964,577, (BENGTSSON)<br>22 June 1976<br>See column 5, line 58 to column 6, line 8 and Figure 1 | 1-2 |
| X<br>Y | EP,A, 0,191,636, (VIDEOVEND BOX OFFICE INC.)<br>20 August 1986<br>See the entire document | 1-2,29<br>---<br>3-7,24 |
| X<br>Y | WO,A, W086/02758, (NYEGAARD ET AL.)<br>09 May 1986<br>See page 24, lines 14-21 | 29<br>--<br>30-31 |
| X<br>Y | WO,A, WO86/06050, (ODETICS, INC.)<br>23 October 1986<br>See page 4, lines 16-18 and Figures 1,2, and 5 | 17<br>--<br>3-7,18-21,49 |

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

## IV. CERTIFICATION

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
|---|---|
| 01 June 1989 | 26 JUN 1989 |
| **International Searching Authority** | **Signature of Authorized Officer** |
| ISA/US | Edward S. Ammeen |

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

| Category * | Citation of Document, with indication, where appropriate, of the relevant passages | Relevant to Claim No |
|---|---|---|
| Y | EP,A, 0,249,367, (BRADT ET AL.) 16 December 1987 See page 16, lines 29-45 and Figure 11 | 24 |
| Y | US,A, 4,573,271, (HAMILTON ET AL.) 04 March 1986 See column 1, line 64 to column 5, line 20 | 7,30-31 |
| Y | US,A, 4,598,810, (SHORE ET AL.) 08 July 1986 See column 4, lines 4-13 | 49 |
| Y,P | US,A, 4,734,005, (BLUMBERG) 29 March 1988 See column 7, lines 59-63 and column 22, lines 1-5 | 4-7,18-21,24 |
| A | US,A, 4,563,120, (JOSSERAND) 07 January 1986 | |
| A | US,A, 4,668,150, (BLUMBERG) 26 May 1987 | |
| A | US,A, 4,389,157, (BERNARD,II ET AL.) 21 June 1983 | |
| A,P | US,A, 4,812,629, (O'NEIL ET AL.) 14 March 1989 | |